Science and Technology

Program Mission

The Environmental Management (EM) cleanup effort is expensive, technologically complex, closely regulated, and relatively unique in the world. Achieving the goal of cost effective cleanup requires targeted investments in science and technology to respond to hundreds of environmental problems identified by cleanup project managers at affected DOE sites. The EM Office of Science and Technology conducts a national program that provides the full range of resources and capabilities--from basic research through development, demonstration and technical and deployment assistance–that are needed to deliver and support fully developed, deployable scientific and technological solutions to Environmental Management cleanup and long-term environmental stewardship problems.

Program Goal

The goal of the Science and Technology program is to provide optimal technological solutions to DOE's cleanup effort through support of peer-reviewed science and technology programs. Science and Technology program activities are performed through teams that address DOE's major environmental problem areas. Referred to as "Focus Areas," these are: Transuranic and Mixed Waste (formerly Mixed Waste); Radioactive Tank Waste; Subsurface Contaminants; Deactivation and Decommissioning; and Nuclear Materials. The Science and Technology program provides users with the most efficient, cost-effective, environmental cleanup technologies and technical solutions possible that enables achieving cleanup according to schedule. This is accomplished through direct participation of the cleanup project manager. Investments in science and technology are planned and managed in an interactive, coordinated, participatory relationship with EM cleanup project managers and stakeholders and include cost and safety analysis. Another goal of the Office of Science and Technology is to provide policy, planning and oversight activities for Long-Term Stewardship, a new programmatic function within the Department.

Program Objectives

The complexity and duration of the EM cleanup effort, combined with regulatory requirements, requires EM to carefully prioritize and sequence cleanup projects. These same factors drive the Office of Science and Technology to rank and prioritize science and technology investments.

EM uses an established multi-objective, decision-analysis approach to prioritize work and to make informed, technology investment decisions. The Work Package Ranking System is an objective scoring system employing five ranking factors. These ranking factors are: 1) meet highest-priority end-user needs; 2) support high-impact projects (projects meeting agreement milestones and/or expensive and multiple site projects); 3) acceleration of future technology deployments; 4) reduction of technical risk (projects at risk for completion as planned due to

a technology deficiency); and 5) reduction of life-cycle project costs. These ranking factors, reflect the programmatic objectives of the Science and Technology program and criteria for program success.

The Work Package Ranking System relies on the baseline planning data supplied by the ultimate end-users of technology solutions - the DOE sites. The life-cycle planning data is collected annually in EM's data collection system - the Integrated Planning, Accountability and Budgeting System Information System. Use of life-cycle planning data prepared by the end-users ensures that science and technology investments reflect EM's overall technical needs, enabling better protection of worker health and safety, reduction of serious risks, regulatory compliance, acceleration of cleanup, and reduced costs.

Technical experts from the Office of Science and Technology work with program managers from Headquarters and the field to ensure that sound science governs the cleanup program and to improve contractor accountability and performance. These experts provide technical support through project reviews and technical assistance in project planning and implementation. The purpose of this support is to ensure: the best value to the government; continued performance in site cleanup and management, including safety and health and compliance with all regulatory requirements; and use of lessons learned.

The Science and Technology program also conducts, in partnership with DOE's Office of Science, and in tandem with the Focus Areas, a basic research program that will result in transformational or breakthough approaches for solving the Department's most intractable environmental problems and will provide the scientific basis for cleanup decisions. In addition to developing technology solutions to enable EM to meet its mission and goals, the Office of Science and Technology has responsibility for the development and implementation of the Department's Long-Term Stewardship program. The objective of the Long-Term Stewardship program is to ensure the protection of human health and the environment after cleanup has been completed at the Department's sites.

Performance Measures

Science and Technology Program

The success of the Science and Technology program, in FY 2002, will be measured by:

- The number of technologies or technology systems (30) demonstrated that meet performance specification-based needs as identified by the Site Technology Coordinating Groups.
- The number of technologies or technology systems (37) made ready for implementation with cost and engineering performance data.

The Science and Technology FY 2002 performance metrics are set at the Project Baseline Summary level, based on past program performance and the budget requested. The complete listing of specific technologies, by Focus Area, that will be demonstrated and made ready for implementation, is made available after the final FY 2002 Science and Technology project level funding is known and FY 2002 current year work plans are finalized by each Focus Area. FY 2002 current year work plans are planned to be finalized by September 30, 2001.

Corporate Environmental Management Program

In addition to the specific performance measures that have been established to measure the success of the Science and Technology program, EM has developed a set of corporate performance indicators related to science and technology that will be reported by the Field Offices. These performance indicators will help to assess how well EM's science and technology investments are managed, and more importantly, how effectively the results or outputs from those investments are being used in cleanup projects. These performance indicators reflect stretch goals that EM will make a commitment to meet but will not be officially reflected or reported in the EM Integrated Planning, Accountability and Budgeting System Information System. The performance indicators that will be used are:

- The number of new technologies deployed for the first time (250) within a project (reported by Project Baseline Summary) and the number of new technologies incorporated into the project baselines (100).
- The percentage of high-priority site needs eliminated that are addressed by the Science and Technology program (25%).
- The percentage reduction in programmatic risk for high-risk waste streams and critical closure path milestones (20%).
- The life-cycle cost savings resulting from the application of science and technology ($500M).

Performance measures for driving and evaluating the Department’s Long-Term Stewardship program are under development.

Significant Accomplishments and Program Shifts

For the last several years, the Science and Technology program has focused on strengthening relationships with the sites and ensuring that all of Science and Technology programs are supporting site needs. In FY 2001, focus is placed not only on technology development, but also on providing technical support to the sites--for example, by gathering technical data needed to support processing decisions and by providing needed expertise to site projects. These efforts have already dramatically improved the number of deployments of Science and Technology-sponsored technologies and provide the added confidence for greater reception of Science and Technology “activities” at the sites. In FY 2001, the Science and Technology program is also working to ensure that its basic and applied research are moving down the technology pipeline. For example, the Focus Areas are managing EM Science Program projects when appropriate, and the Science and Technology program is developing an applied research program for EM Science Program projects that may not be ready for the Focus Areas or that may be crosscutting. In FY 2001, the Department established the Long-Term Stewardship program within the Office of Science and Technology to address DOE's long-term responsibilities for sites beyond closure.

In FY 2002, the Science and Technology program will continue these efforts and, in addition, will be reevaluating its programs and developing a strategy for the long term in light of its role with the sites and the need to plan for long-term stewardship as sites are closed. The Science and Technology program will evaluate

programs for balance – in terms of both balance across the technology gate structure (technical maturity) and balance across problem areas. The Science and Technology program will also establish criteria incentives for ending projects—for example, for reasons of changing needs, technical quality, or because the project is sufficiently complete—and include these criteria in our review of programs. At the request of the EM sites, the scope of Science and Technology work will be expanded to address spent fuel issues. In FY 2002, the Office of Long-Term Stewardship will continue planning and, in partnership with the sites and stakeholders, focus on resolution of stewardship issues that are delaying closure at some sites. In addition, the Science and Technology program will evaluate research needs for long-term stewardship and which of those needs are being met by existing research). Research in this area will be conducted by the Focus Areas or the EM Science Program, as appropriate.

Radioactive Tank Waste Remediation Focus Area

In FY 2001, the Science and Technology program increased its scope to directly support the Savannah River high-level waste tank program to develop an alternative approach to in-tank processing for cesium removal from high level waste. Two of the three options being considered for "salt processing" (cesium removal) at Savannah River were developed by the Science and Technology program. Based on basic research performed by DOE's Office of Science, the EM Science Program and the Radioactive Tank Waste Remediation Focus Area, a new solvent extraction method at Oak Ridge National Laboratory and a new ion exchange method at Sandia National Laboratory in partnership with Texas A&M University was developed. Without the work performed in these programs, Savannah River would have had to begin development of new alternatives, requiring a minimum of four to five years and resulting in further major processing delays. In FY 2002, the Science and Technology program will continue to support the tank program at Savannah River site. In addition, the Science and Technology program will work with Hanford to increase its role in support of the Office of River Protection.

Since high-level wastes pose many of the most challenging technical issues in the weapons complex, the EM Science Program has supported numerous basic research projects in this area for the last three years. In FY 2001, the Science and Technology program increased its efforts to integrate and further develop appropriate EM Science Program projects in the Radioactive Tank Waste Remediation Focus Area and will continue this emphasis in FY 2002.

Major accomplishments in FY 2001 include:

- In partnership with the Savannah River Site, the technical evaluation and selection of a primary technology for salt processing will be completed. This will allow the site to move forward with preliminary design.
- The Science and Technology program will lead an independent assessment of improved melter technologies, improved waste loading, waste processing, and waste forms for Hanford tank wastes. The findings from this assessment will be implemented as part of the phase II cleanup at Hanford.
- An integrated robotics system of commercial technologies will be demonstrated at Hanford. The system will result in improved operations at the tank farms and significantly reduce health and safety risks.

In the EM Science Program, a new technology is being pursued at Sandia National Laboratory that acts as a molecular "sponge" in that it captures and stores radioactive strontium from liquid hazardous waste. When heated, these sponges turn into a stable material that shows promise of being well suited for disposal. Also, researchers from the Pacific Northwest National Laboratory and Florida State University have developed a model which helps to predict the conditions that could plug pipelines during transfers of radioactive tank waste. Researchers from the Pacific Northwest and Lawrence Berkeley National Laboratories and University of Texas worked with site safety personnel to improve the understanding and prediction of flammable gas generation in the tanks.

Major accomplishments in FY 2002 include:

The completion of research and development for the primary Savannah River cesium removal technology and support of design and construction of a salt processing pilot plant and ultimate full-scale facility for processing of 30 million gallons of high level waste. In addition, the Science and Technology program will continue development of an alternative process until the primary process has been proven at pilot-scale on actual waste.

Analyses of the melter assessment completed in FY 2001 will serve as the basis for determining research and development required to provide data for potential improvements in melter technologies currently identified for use at Hanford, Idaho and Savannah River sites.

The Radioactive Waste Tank Remediation Focus Area will demonstrate alternate methods for immobilized high-level waste canister decontamination to support both the West Valley Demonstration Plant and the Savannah River Site that will reduce secondary waste volumes and processing costs.

Technologies for single shell tank retrieval at Hanford, including fluidic mixing and low-density gradient salt dissolution developed by AEA Technologies, will be demonstrated and recommended for use.

At the Idaho National Engineering and Environmental Laboratory, deploy a calcine-sampling technology that will enable sampling, for the first time, of high-level waste calcine and will provide the technical data required for retrieval and processing decisions at the Idaho National Engineering and Environmental Laboratory. Demonstrate a filter leach process at the Idaho National Engineering and Environmental Laboratory and deploy waste minimization technologies to reduce volume of newly generated waste.

Subsurface Contamination Focus Area

In FY 2001, the Science and Technology program is providing technical assistance to most of the DOE sites in support of technology selection and conceptual design for environmental restoration activities. The Subsurface Contaminants Focus Area has also made tremendous progress in the demonstration and deployment of technologies to address chlorinated solvents, also known as Dense Non-Aqueous Phase Liquids and in the understanding and characterization of vadose zone contamination. The Subsurface Contaminant Focus Area will begin in FY 2001 and continue in FY 2002 to support Long-Term Stewardship issues—much of the research in this program as well as in the EM Science Program is directly relevant to stewardship (e.g. long-term monitoring and improved cap materials).

Major accomplishments in FY 2001 include:

- Through a partnership with other agencies, the Science and Technology program will complete a joint demonstration at Cape Canaveral for the optimization of three aggressive technologies which can reduce the clean up of Dense Non-Aqueous Phase Liquids contaminated sites to a few years rather than tens of years. The three technologies are; Dynamic Underground Stripping, Six-Phase Soil Heating , and In-Situ Oxidation. Dynamic Underground Stripping has been used three times at DOE, and in FY 2001 will be deployed at the Savannah River Site 321-M solvent storage area.

- At Los Alamos, the small-scale deployment of a novel bottoms–up approach for in-situ vitrification will be completed. This new process has demonstrated that in-situ vitrification is a safe and viable technology for the destruction of organic material and the stabilization of metals and radionuclides in the soil.

- The Science and Technology program's development of improved caps and covers as well as long-term monitoring devices for landfills is now paying off in support of the closure sites. At Nevada, a new single layer cover design will be deployed in FY 2001 and a similar cover will be deployed at Sandia in FY 2002. Rocky flats has also been participating in this activity in order to obtain the data needed to design the caps for their site.

- In partnership with Fernald, establish a long-term monitoring test bed at the Fernald on-site disposal cell and evaluate the performance of two downhole-monitoring instruments. A network of advanced tensiometers developed by Idaho National Engineering and Environmental Laboratory will be deployed around the Hanford tanks to provide the ability to measure and detect the direction of groundwater flow around the tanks. This information along with flow models developed by the Subsurface Contaminants Focus Area will allow better prediction of the flow of contaminants away from the tanks.

- In the EM Science Program, a University of Georgia team is using genetic engineering to incorporate "single-genetraits" into plants, enabling the plants to process heavy metals and thereby remediate heavy-metal contamination. They have successfully engineered a small model plant to use a highly modified bacterial mercuric ion reductase gene to detoxify ionic mercury, reducing it to much less toxic metallic mercury. This method of remediation is applicable to areas where soils are contaminated with mercury to a shallow depth, such as the Oak Ridge and numerous industrial sites outside the DOE complex. This is a minimally destructive and low cost alternative to soil excavation and removal.

Major accomplishments in FY 2002 include:

- Demonstrate at a competitively selected site, an innovative hot point Dense Non-Aqueous Phase Liquid characterization tool which will be used as the new baseline technology for Dense Non-Aqueous Phase Liquid detection and two advanced characterization techniques will be deployed for the first time. The first, High Resolution Borehole Seismic imaging for mapping sources of Dense Non-Aqueous Phase Liquids contamination will be deployed at Pinellas and Idaho (Test Area North). The second technology, the Through Casing Resistivity Tomography process, developed at the Idaho National Engineering and Environmental Laboratory, will be deployed at the Hanford Tank Farm to map moisture zones beneath tanks. If successful, both of these new characterization techniques should rapidly become the baseline across all of DOE as there is no simple, minimally intrusive tool to locate the source of Dense Non-Aqueous Phase Liquid contamination or measure soil moisture.

- Deploy alternative landfill cover design and monitoring system at Nevada to meet state and federal regulatory compliance requirments. Data generated will be used to answer questions on barrier lifetime in arid environments. Significant cost and time savings will be the result of these efforts.
- Deploy bioremediation technologies for the in situ destruction of carbon tetrachloride Dense Non-Aqueous Phase Liquid plumes at Oak Ridge and Richland. The use of this methodology for Dense Non-Aqueous Phase Liquids remediation in deep and difficult geologies will greatly reduce the cost and risk of migrating plumes resulting from these sources. The plume at Richland extends for approximately seven miles and is migrating in the direction of the Columbia River while the Oak Ridge contaminants are located in fractured and karst environments. This passive method of destruction will result in great risk and cost reductions for both sites.
- Complete deployment of the Reactive Barrier for the remediation of the extensive Dense Non-Aqueous Phase Liquid plume at Paducah. This site is utilizing this technology to address concerns from local stakeholders and state regulators. This will allow the Paducah site to meet the commitments to the regulatory agencies for this problem. This will also enhance the Subsurface Contaminants Focus Area's ability to support other sites in their efforts to utilize monitored natural attenuation to meet their compliance commitments.
- Demonstrate characterization and remediation methods, which are being developed through the EM Science Program, for vadose zone basic research. These technologies/systems will be used to address contaminant identification, fate and transport and remediation/stabilization underneath the high level waste tanks at Richland and underneath facilities and infrastructure at locations such as Rocky Flats, Pantex and Ohio sites.
- In partnership with Ohio Operations Office, deploy multiple real-time sensors and monitors for the Fernald Post Closure Monitoring Test Facility. This project will assist Ohio in meeting their closure date of 2006 and also provide the testing required to meet regulatory guidelines for other site closure plans.
- Continue applied research projects, from awards made in FY 2001, in the areas of characterization, modeling, and monitoring; separations and plugging phenomena related to the performance of reactive barriers, and tritium detection and remediation.

Transuranic and Mixed Waste Focus Area

In FY 2001, the Science and Technology program focused on two major issues: better characterization and packaging of transuranic waste for shipment to the Waste Isolation Pilot Plant and the identification of alternatives to incineration. In 2002, the Science and Technology program will focus on implementation of remote modular transuranic waste repackaging systems and demonstration of alternatives to incineration at the pilot-scale level.

Major accomplishments in FY 2001 include:

- Two new non-destructive assay systems were deployed. The Combined Thermal Epithermal Neutron Radio-assay was used at Los Alamos National Laboratory to allow the Waste Isolation Pilot Plant certification of drums containing radionuclides in complex waste mixtures; and, the Transuranic Optimized

Measurement System was implemented at the Savannah River Site to appropriately classify waste drums that do not contain Plutonium-238 as low-level waste rather than transuranic. These systems reduce both costs and human exposure by improving sensitivity and by allowing the characterization to be performed without opening the drums.

- In support of the Secretary of Energy's Blue Ribbon Panel on Emerging Technological Alternatives to Incineration, the Science and Technology program will provide technical information and plans to select three alternative technologies matched to specific waste streams in DOE for pilot scale testing in FY 2002.
- Deploy the Gas Vitrification system, an alternative to incineration developed by the Transuranic and Mixed Waste Focus Area three years ago, at the Hanford site to treat mixed waste.
- Deploy a process for reducing the confinement layers in existing transuranic waste drums at the Idaho National Engineering and Environmental Laboratory to increase the amount of waste to be placed in each Transuranic Waste Package Transporter without first treating or repackaging the waste. Deployment of this process will reduce transuranic transportation and disposal costs, as well as, reduce human exposure.

Major accomplishments in FY 2002 include:

- Complete demonstration of the "HANDS–55" unit which will be used to separate Plutonium-238 contaminated material from stored waste to allow the remaining waste to be shipped to Waste Isolation Pilot Plant without further treatment. Since this is a remote system, it will reduce human exposure and treatment costs as well as enable a substantial amount of waste to be removed from the Savannah River site.
- An alternative oxidation process to remove the organic material from the remaining Plutonium-238 job-control waste will also be demonstrated at Savannah River to enable shipment of waste to the Waste Isolation Pilot Plant and to enable Savannah River to meet shipment schedules.
- Deploy a particulate matter continuous emissions monitor at the Oak Ridge Toxic Substance Control Act Incinerator. Deployment of this monitor will enable operation of the Toxic Substance Control Act incinerator through 2003 under the Maximum Achievable Control Technology compliance rule.
- Consistent with recommendations resulting from the Secretarial-commissioned Blue Ribbon Panel on Emerging Technological Alternatives to Incineration, initiate the demonstration of three alternatives selected in FY 2001 at pilot scale.
- Work will continue on improvements to transuranic transportation. The Transuranic and Mixed Waste Focus Area will demonstrate Hydrogen Gas Getters at Savannah River, Idaho National Engineering and Environmental Laboratory, and Los Alamos National Laboratory sites to reduce hydrogen gas build up in waste drums. This will allow a greater waste loading for the Transuranic Waste Package Transporter reducing the cost of transportation and disposal, as well as, reducing human exposure by eliminating the need for treating or repackaging the transuranic waste prior to loading into the Transuranic Waste Package Transporters.

Deactivation and Decommissioning Focus Area

Work in decontamination and decommissioning in FY 2001 is centered on the completion of four large-scale demonstration and deployment projects at Savannah River, Idaho, Los Alamos National Laboratory, and Mound, as well as, providing technical assistance to Rocky Flats for improving safety and efficiency for the size reduction and disposal of contaminated gloveboxes. Basic and applied research needs for decontamination and decommissioning, such as better characterization and new methods for separations of radionuclides from very dilute waste streams, have become more apparent

now that the sites are performing decontamination and decommissioning of facilities in order to reach closure. For this reason, the EM Science Program initiated a number of research projects in the decontamination and decommissioning area in FY 2001.

In FY 2002, the Science and Technology program will continue to support activities related to deactivation and decommissioning of fuel pools and continue, from FY 2001, the demonstration of technologies for the characterization, sorting, decontamination, size reduction, and segregation of materials to support cost-effective disposition and reuse options of newly generated and stockpile legacy materials.

Major accomplishments in FY 2001 include:

- At Idaho, Science and Technology innovations will be used to completely characterize two underwater reactor units allowing the preliminary design for the removal of the reactors as a single unit rather than having to perform expensive underwater decontamination and size reduction. By deploying 10 innovative decontamination and decommissioning technologies, it is estimated that an $8.7 million cost savings will result across the Idaho National Environmental and Engineering Laboratory over a 10 year period.
- Continue the Rocky Flats initiative to improve the efficiency and safety of glove box disposal by enabling the movement from workers with hand tools physically disassembling the glove boxes to remotely controlled equipment working in a confinement chamber with minimum human exposure. A key component of the improved Rocky Flats process is the Standard Waste Box Counter. It allows for disposal of larger pieces of material than a 55 gallon drum and can perform an assay on the entire wastebox at one time rather than assay individual pieces, allowing faster loading and higher waste volumes.
- Begin Mound Long-Term Stewardship initiative to deploy real-time, autonomous surveillance and monitoring systems that will provide DOE, regulators, and other public stakeholders the assurance that the public and the environment are protected after final decontamination, decommissioning and site cleanup is completed. This initiative will be coordinated with the Subsurface Contaminant Focus Area.
- Researchers in the EM Science Program are developing a new class of radionuclide and heavy metal complexation agents that are tagged with near-infrared dyes for use as a compact and portable "laboratory-on-a-chip" for site characterization and remediation. Collaboration with the Deactivation and Deactivation Focus Area to refine the project direction has resulted in commitments to support field-testing. This technology has broad applications in monitoring and characterization of contaminants including the monitoring of mixtures of radionuclides and other materials (e.g., concrete drill samples in deactivation and decommissioning applications). This technology provides rapid analysis of samples, making it highly desirable for field screening for contaminants, where previously used methods would require operations to cease until analyses were completed, for days or even weeks.

Major accomplishments in FY 2002 include:

- Continue deployment of centralized and in-situ remote/robotic technologies and systems within the Rocky Flats initiative to improve the efficiency and safety of glove box disposal. These improved systems will provide an estimated $80 to $100 million in cost savings over baseline approaches, reduce worker safety and health risk, and accelerate decontamination and decommissioning schedules, thereby helping Rocky Flats achieve site closure goals.
- Continue the Mound Long-Term Stewardship initiative begun in FY 2001. This initiative, conducted in cooperation with the Subsurface Contaminants Focus Area, will serve as a prototype for long-term stewardship of DOE facilities and equipment.
- Demonstrate and deploy a telerobotic manipulation system for canyon process cells at Hanford. This system has applications to equipment removal and size reduction operations at the canyon facilities at Hanford and Savannah River.
- Deploy tritium decontamination and decommissioning technologies at Los Alamos National Laboratory Tritium Systems Test Assembly facility. Removal of the tritium contamination will result in a downgrade of the Tritium Systems Test Assembly facility from a Category 2 nuclear facility to a Category 3 radiological facility thereby lowering the mortgage costs associated with surveillance and maintenance activities of the building.
- Continue demonstration of improved technologies for the characterization, sorting, decontamination, size reduction, and segregation of materials to support cost-effective disposition and reuse options of newly generated and stockpile legacy materials.

Nuclear Materials Focus Area

In FY 2001 and FY 2002, the Science and Technology program will expand the Nuclear Materials Focus Area to better meet the needs of the sites. The near-term goals for the Nuclear Materials Focus Area are to support closure sites, such as Fernald and Rocky Flats, by providing the needed technologies and expertise to allow the shipment of nuclear materials off the sites for proper disposal. In FY 2002, we will continue to provide a range of stabilization technologies for plutonium and other nuclear materials to support their removal from the closure sites. The Office of Science and Technology will also significantly increase support for spent nuclear fuel storage and disposal.

Major accomplishments in FY 2001 include:

- At Rocky Flats and Hanford, a supercritical fluid extraction method for reliable moisture measurement will be deployed at Rocky Flats and Hanford, and will be deployed at Savannah River in FY 2002. Sufficiently low moisture levels of plutonium-containing wastes must be achieved before a site can ship the material to Savannah River for treatment. This new method, far more accurate than previous methods, prevents erroneously high readings, thereby avoiding slow and costly repackaging of materials. The overall cost avoidance these deployments will provide has been estimated at greater than $20 million.

- At the Hanford Plutonium Finishing Plant the Nuclear Materials Focus Area will provide a new annealing furnace system that reduces the furnace cycle time from 16 hours to 3 hours. The increased production of the plant will be important to meeting both the Defense Nuclear Facilities Safety Board milestone for plutonium solution stabilization and the Hanford site closure milestone for the Plutonium Finishing Plant.
- At Fernald, a vacuum transfer system will be deployed to reduce human exposure during the transfer of uranium materials into shipping containers.
- Large quantities of spent nuclear fuel at Hanford, Savannah River, and Idaho National Engineering and Environmental Laboratory, will be moved from water-storage into dry interim storage, where it will remain for several decades prior to final disposition. Current DOE strategies for spent nuclear fuel preprocessing, processing, and dry storage appear to be highly conservative since a comprehensive mechanistic model tested on actual fuel rod behavior is not available. The test data could improve the model predictions which in turn could lead to more cost-effective strategies. As one step towards such a model, the science underlying moisture retention by spent nuclear fuel during drying and its influence on subsequent radiolytic gas generation, corrosion, and surface stability and reactions is underway in a collaborative effort involving Pacific Northwest and Brookhaven National Laboratories and Rutgers University.

Major accomplishments in FY 2002 include:

- A prototype high integrity storage can will be designed and demonstrated to serve as replacement cladding for the disrupted spent nuclear fuel, enabling transport and dry storage of spent nuclear at the Idaho National Engineering and Environmental Laboratory in accordance with compliance schedules. Experience from prototype construction will be used to guide design of the high integrity can for long-term storage and ultimate disposal of disrupted spent nuclear fuel at the Idaho, Hanford and Savannah River sites.
- A nondestructive assay method will be developed for spent nuclear fuel canisters at all major sites to quantify the fissile material content. Absence of this capability is one major barrier to assuring approval of site plans for disposal at Yucca Mountain.

Uncertainties are inherent in any research program, and the allocations of funding requested within represent the best estimates at the time this budget was formulated. It is possible that as circumstances change, or new higher-priority needs and risks are identified by the EM sites, it may be necessary to redirect funds within the Science and Technology program categories to accommodate these changes.

FY 2002 Budget Summary [a]

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
Radioactive Tank Waste Remediation Focus Area	43,882	55,558	55,825

The Radioactive Tank Waste Remediation Focus Area addresses 80 high priority needs in the development and deployment of technical solutions to remove high-level waste in over 280 large radioactive and other miscellaneous underground storage tanks across the DOE complex and processing the waste for final disposal. Closure of these tanks, which currently contain approximately 90 million gallons of radioactive waste, will mitigate further risks to groundwater and surrounding populations, and contribute significantly to mortgage reduction. The Radioactive Tank Waste Remediation Focus Area will assist individual sites in the deployment of science and technology to reduce risk and cost; enable baseline tank remediation to be implemented, thereby accelerating cleanup at those sites; and maintain sound program management and integration processes. The Radioactive Tank Waste Remediation Focus Area includes the following planned FY 2002 activities:

Tank Waste Retrieval and Closure (FY 2002 funding $26,940,000) science and technology development will focus on systems to retrieve and transfer sludges and tank waste residues to enable continued processing and tank closure at the Idaho National Engineering and Environmental Laboratory, Oak Ridge Reservation, Savannah River Site, Hanford Site and the West Valley Demonstration Project. Techniques will be developed and deployed to ensure tank integrity prior to and during retrieval operations, reduce risk of waste transfer line plugging, improve tank farm operations to support waste retrieval, and enable tank waste stabilization for ultimate tank closure.

Tank Waste Pretreatment and Immobilization (FY 2002 funding $28,885,000) science and technology will be developed and deployed to improve high-level waste immobilization processes through increased waste loading, new canister decontamination methods, and advanced melter design. Development and demonstration activities will provide alternative paths to salt waste treatment to replace in-tank precipitation at Savannah River Site, and enable integrated flow sheet design for pretreatment and immobilization activities at the Idaho National Engineering and Environmental Laboratory.

[a] The following seven pages are a synopsis of the budget request for the Office of Science and Technology and is provided for ancillary information.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
Subsurface Contaminants Focus Area	41,508	40,729	32,465

The Subsurface Contaminants Focus Area addresses technological solutions for the 5,000 DOE plumes that contaminate 1.7 trillion gallons of groundwater and 40 million m^3 of soil. Approximately three million m^3 of solid radioactive and hazardous wastes buried in landfills and trenches must be contained so they do not leach and further contaminate soil and groundwater. The EM sites' baseline planning data include 80 high priority needs for the development and deployment of technologies to remediate contaminated soil and groundwater. The Subsurface Contaminants Focus Area divides its work to solve these problems into three areas: Destruction of dense non-aqueous phase liquids, primarily chlorinated organic solvents that are now polluting groundwater from localized underground pools; containment or stabilization of concentrated waste in landfills, trenches, and around leaking high-level waste tanks; and treatment or stabilization of hazardous metals and radionuclides dispersed in soils and groundwater. This focus area will assist individual sites in the deployment of science and technology to reduce risk, cost, accelerate cleanup, and maintain sound program management and integration processes. The Subsurface Contaminants Focus Area includes the following planned FY 2002 activities:

Dense Non-Aqueous Phase Liquids (FY 2002 funding $13,650,000) constitute a generic class of particularly difficult to locate, quantify, and treat or destroy organic compounds that contaminate both the vadose and saturated zones at many DOE sites. Activities will focus on better understanding the long-term movement and fate of these contaminants to better design treatment strategies. Treatment systems will be demonstrated and deployed, including advanced bioremediation and natural attenuation, in-situ passive and reactive barriers, and in-situ treatment technologies applicable to a broad range of geologies in the vadose and saturated zones, including deep access.

Source Term Containment/Source Term Remediation (FY 2002 funding $8,321,000) prevents the further spread of contaminants to limit associated risks and cleanup costs. Technologies for improved longer life surface caps, landfill stabilization, and verification and monitoring systems will be demonstrated. An improved understanding of the long-term performance of containment materials and systems is required to bridge the gap between short-term activities and long-term stewardship. Advanced integrated monitoring systems will be demonstrated and a verification and monitoring system architecture supporting long-term stewardship of caps and surface covers will be established. Landfill closure design guidance to maximize design life for application across the complex will be developed.

Metals and Radionuclides in the Vadose and Saturated Zones (FY 2002 funding $10,494,000) cannot be destroyed and therefore, must be either stabilized or removed. Chemical stabilization can reduce metal toxicity or mobility and allow for the natural attenuation of radionuclides. Efforts will continue to develop improved characterization, monitoring and modeling techniques. Technologies will be deployed to chemically stabilize or remove contaminants at Richland and Albuquerque.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
Transuranic and Mixed Waste Focus Area	28,067	31,870	23,067

The Transuranic and Mixed Waste Focus Area provides technical and engineering solutions for supporting effective, efficient mixed waste treatment technology systems. Site Treatment Plans identified about 154,000 m^3 of mixed and transuranic waste in storage that includes over 754 mixed waste streams. About 108,000 m^3, or 70 percent of the total inventory, is categorized as transuranic. The Environmental Management sites' baseline planning data has identified 60 high priority technology needs in the mixed and transuranic waste areas. This focus area will assist in the deployment of science and technology at individual sites to reduce risk, cost, accelerate cleanup, and implement and maintain sound program management and integration processes. The Transuranic and Mixed Waste Focus Area includes the following planned FY 2002 activities:

Transuranic Waste Handling and Characterization (FY 2002 funding $11,456,000) solutions are being developed to characterize radionuclide components in boxes destined for disposal at Waste Isolation Pilot Plant or another Resource Conservation and Recovery Act subtitle C facility, to enhance payload capacity of transuranic waste containers, and to develop automated handling systems for transuranic and mixed waste material during characterization, treatment, packaging, and disposal.

Mixed Transuranic and Mixed Low-Level Treatment Alternatives (FY 2002 funding $11,611,000) are being developed as an option to high temperature treatment systems because of the low risk and high regulatory and public acceptance. Activities will include alternative oxidation technology treatment and stabilization alternatives for plutonium-238 contaminated waste and polychlorinated biphenyl mixed waste. In addition, development of emissions control technologies will continue to address technical concerns created by deployment of alternative treatment technologies and the Maximum Achievable Control Technology for Hazardous Waste Combustors Rule including emissions of mercury, dioxins and furans.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
Deactivation and Decommissioning Focus Area	26,322	27,105	17,555

The Deactivation and Decommissioning Focus Area develops, demonstrates, and facilitates implementation and deployment of safe and cost effective technologies that address real needs pertaining to the 20,000 radiologically/hazardous waste contaminated buildings and facilities. The near-term goal is to reduce the EM deactivation and decommissioning mortgage by 25 percent and 50 percent in the long-term (i.e. post 2006), for a net reduction of approximately $5,000,000,000. The EM sites' baseline planning data has identified 38 high priority needs. Within the funding provided, this focus area will assist individual sites in the deployment of science and technology to reduce risk, cost, accelerate cleanup, and maintain sound program management and integration processes. The Deactivation and Decommissioning Focus Area includes the following planned FY 2002 activities:

Reactor Facilities (FY 2002 funding $1,844,000) Research and development activities will be conducted to address long-term surveillance and monitoring associated with the interim safe storage and long-term stewardship of DOE's surplus production reactors until such time that final disposition occurs. Of special interest is the advanced development of characterization techniques that will allow for screening to levels which will permit the release of facilities and equipment.

Radionuclide Separation Facilities (FY 2002 funding $7,713,000) Improved technologies are required to deactivate and decommission radionuclide separation facilities, including gaseous diffusion plants, chemical separation facilities, uranium recycling facilities and lithium enrichment facilities. These facilities typically have large volumes of contaminated equipment and miles of contaminated process piping, which will become a significant waste issue as these facilities are deactivated and decommissioned. Primary emphasis will be to demonstrate technologies for the safe and cost-effective disposition of stockpiled legacy waste (e.g. contaminated scrap metal and concrete debris) as well as technologies that will minimize the impacts of future waste generated from deactivation and decommissioning activities. In FY 2002 efforts will be continued to develop remote/robotic systems to address long-term deactivation and decommissioning of DOE's processing facilities. Robotic systems will be integrated with "smart" sensors to conduct long term facility monitoring and surveillance activities.

Fuel and Weapons Component Fabrication Facilities (FY 2002 funding $7,998,000) Improved and innovative technologies are required to deactivate and decommission fuel and weapon component fabrication facilities including fuel, target and weapon component fabrication facilities, and weapons assembly and dismantlement. In FY 2002, efforts will continue to provide assistance to the DOE closure sites (e.g., Rocky Flats, Mound and Fernald) for the deployment of improved and innovative technologies that will be safer, more cost-effective and accelerate deactivation and decommissioning schedules so that critical closure milestones can be met. Of particular concern is the ability to safely dismantle and remove the hundreds of contaminated gloveboxes that exist at these sites. Improved systems will be deployed including remote size reduction and removal systems, improved decontamination and treatment systems, and technologies for characterizing, assaying and handling waste materials. Additionally, once these sites complete their closure milestones, they will need to conduct long-term surveillance and monitoring to assure that the public and the environment are safe from residual radiation that may still reside on site. In FY 2002, increased emphasis will be placed on the Long-Term Stewardship Initiative at Mound which was initiated in FY 2001. This project will support the deployment of real-time, autonomous systems that will provide long-term monitoring and data collection, storage and reporting on the condition of remaining building and the surrounding soils.

	(dollars in thousands)		
	FY 2000	FY 2001	FY 2002
Nuclear Materials Focus Area	4,001	7,954	9,647

The Nuclear Materials Focus Area supports the safe management and expeditious stabilization of nuclear materials currently under the purview of the Office of Environmental Management. Technical solutions to the

broad range of challenges associated with management of nuclear materials will be identified and provided to the EM complex. The EM sites' baseline planning data has identified 36 high priority needs in the nuclear materials problem area. Within the funding provided, the Nuclear Materials Focus Area will assist individual sites in the deployment of science and technology to reduce risk, cost, accelerate cleanup, and maintain sound program management and integration processes. The Nuclear Materials Focus Area includes the following planned FY 2002 activities:

Stabilization Technology Development (FY 2002 funding of $4,900,000) will focus on developing improved processes to stabilize plutonium (approximately 20 metric tons) left in the weapons production pipelines in various storage configurations and plutonium residues (approximately 150 metric tons) and materials processing techniques to address the widely varying chemical and physical forms of EM nuclear materials.

Materials Processing (FY 2002 funding of $1,083,000) will focus on development of aqueous processing technologies for residue materials and other problematic materials that exist in the DOE complex. A secondary focus will address separation processes for metal, salt, and oxide residues.

Spent Nuclear Fuel (FY 2002 funding of $3,664,000) will focus on development of stabilization, characterization, and packaging technologies for storage and disposal of spent nuclear fuel. Activities will also include developing standards for packaging to lower the costs of developing storage facilities.

(dollars in thousands)

	FY 2000	FY 2001	FY 2002
Environmental Management Science Program	31,235 [a]	36,919 [b]	32,050 [b]

The EM Science Program was created to support scientific research essential to solve the cleanup problems of the Nation's nuclear weapons complex. The program's objective is to improve the effectiveness of the cleanup effort over the long-term. The importance of basic scientific research to the cleanup mission was established in the Secretary of Energy Advisory Board (Galvin) Report: "There is a particular need for long-term, basic research in disciplines related to environmental cleanup...Adopting a science-based approach that includes supporting development of technologies and expertise could lead to both reduced cleanup costs and smaller environmental impacts at existing sites and to the development of a scientific foundation for advances in environmental technologies."

The EM Science Program represents a partnership between DOE's Office of Science and EM. The Office of Science manages the solicitation of proposals and scientific review process. EM ensures that the research is

[a] $765,000 transferred to DOE Office of Science for award and administration of grants to small businesses.

[b] Includes Small Business Innovative Research assessment in the amount of $925,000 in FY 2001 and $765,000 in FY 2002.

relevant to the Department's cleanup problems. Science projects funded to date focus on critical problems identified through: 1) workshops at Hanford, Savannah River, Oak Ridge, and Idaho; 2) a complex-wide needs survey; 3) solicitation of science research needs that address problems as identified by the EM sites' baseline planning data; 4) independent development of long-term research plans; and 5) a systems engineering analysis. To date, of the 316 projects selected, 132 focus on science needed to improve subsurface contamination including contamination in the vadose zone; 81 focus on finding better ways to treat and destroy high-level waste; 35 focus on waste containing a mixture of radioactive and other hazardous materials (mixed waste); 29 focus on better understanding the health and ecological effects associated with environmental cleanup options; 8 address the materials used in weapons production (nuclear materials); 23 projects focus on technical problems with facility deactivation and decommissioning, and the remaining 8 projects focus on spent nuclear fuel stabilization and disposal. This competitive program has been effective in establishing a link between the EM program and the scientific community. Thirteen of DOE's national laboratories and 90 academic institutions, and 22 other Federal laboratories and industrial organizations currently participate in the program. FY 2000 is the last year of funding for the 66 projects funded in FY 1997, a $46,400,000 investment; FY 2001 is the last year of funding for the 33 projects funded in FY 1998, a $20,500,000 investment; and FY 2002 is the last year of funding for the 39 projects funded in FY 1999, a $32,811,239 investment. In FY 2000, competitive renewal awards were issued to 42 of the most promising research awards originally selected in FY 1996 and FY 1997. In FY 2001, 30 to 45 new awards will be initiated to address issues related to high-level waste and deactivation and decommissioning. In FY 2002, 10 to 15 new awards will be initiated to address issues related to subsurface contamination and long term stewardship.

(dollars in thousands)

	FY 2000	FY 2001	FY 2002
Idaho Environmental Systems Research and Analysis	33,273	21,000	0

The Idaho National Engineering and Environmental Laboratory supports EM in its long-term cleanup mission by developing and maintaining critical environmental science capabilities, environmental research, and support for the transition of basic science to engineering applications and problem solutions. Due to the need to address higher priority requirements identified by the EM sites, no funding is included for the Environmental Systems Research and Analysis program in the FY 2002 Congressional Budget request.

(dollars in thousands)

	FY 2000	FY 2001	FY 2002
Technology Applications	19,978	19,254	15,891

The Technology Applications program supports the broad acceptance and deployment of available and emerging innovative technologies; the collection, analysis, and communication of project specific data and program information; facilitates the implementation of sound business management practices; interacts with the international scientific and technical community; and assists in science and technology laboratory management policy and review.

Program Information, Review, and Analysis (FY 2002 funding $6,421,000) activities will focus on Office of Science and Technology strategic planning; developing and implementing laboratory management policy and review; ongoing programmatic and technology reviews; and information systems, communication products, and analysis. Activities are focused on providing and improving effective and credible information and information management systems, communications planning and products, business management support, independent program and technology assessments and peer reviews, and assistance to and consolidation of field cost savings analysis.

Deployment Assistance (FY 2002 funding $5,370,000) Site technology acceptance is facilitated by identifying site needs to the focus areas as early as possible to ensure the focus areas are working on the right problems. Site participation in technology deployment planning and workshops to encourage use of innovative technologies are also included.

International Technology Coordination (FY 2002 funding $600,000) activities will focus on the facilitation of international technical workshops to receive benefit of international technologies and expertise and oversight of Office of Science and Technology international activities.

Safety and Regulatory (FY 2002 funding $3,500,000) activities will focus on worker health and safety assessments of high-impact environmental technologies and assisting states in establishing technology acceptance verification protocols and reciprocity guidelines to expedite multi-state permitting and multi-site technology deployment.

(dollars in thousands)

	FY 2000	FY 2001	FY 2002
Small Business Innovative Research Program (Technology Development)	0 [a]	3,723	1,500

Funding is requested for the Small Business Innovative Research assessment in accordance with Public Law 102-564, which mandates a percentage of all research and development dollars be set aside for grants to small businesses. Once funding is appropriated, it is transferred to the DOE Office of Science for award and administration of grants to small businesses.

[a] $3,659,000 transferred to DOE Office of Science for award and administration of grants to small businesses.

(dollars in thousands)

	FY 2000	FY 2001	FY 2002
Long-Term Stewardship	1,500	8,000	8,000

In late 1999, the Department established the new Office of Long-Term Stewardship within the Office of Science and Technology program. The mission of the Office of Long-Term Stewardship is to ensure the sustainable protection of human health and the environment after cleanup is completed, sites are closed, waste is emplaced for disposal, or facilities are stabilized for long periods while awaiting further remediation. The Long-Term Stewardship program is responsible for the overall Environmental Management Long-Term Stewardship coordination and management including: establishing policy, issuing guidance, conducting oversight, coordinating information, determining science and technology needs, and liaison to stakeholders groups throughout the Department of Energy and coordination with other Federal and State organizations and other external organizations.

Funding Profile

(dollars in thousands)

	FY 2000 Comparable Appropriation	FY 2001 Original Appropriation	FY 2001 Adjustments	FY 2001 Comparable Appropriation	FY 2002 Request
Radioactive Tank Waste Remediation Focus Area	43,882	57,740	(2,182)	55,558	55,825
Subsurface Contaminants Focus Area	41,508	41,229	(500)	40,729	32,465
Transuranic and Mixed Waste Focus Area	28,067	28,870	3,000	31,870	23,067
Deactivation and Decommissioning Focus Area	26,322	26,855	250	27,105	17,555
Nuclear Materials Focus Area	4,001	7,954	0	7,954	9,647
Environmental Management Science Program	31,235 [a]	37,000 [b]	(81)	36,919 [b]	32,050 [b]
Idaho Environmental Systems Research and Analysis	33,273	21,000	0	21,000	0
Technology Applications	19,978	20,283	(1,029)	19,254	15,891
Small Business Innovative Research Program (Technology Development)	0 [a]	3,723	0	3,723	1,500
Risk Policy Program	0 [c]	2,000 [c]	(2,000)	0 [c]	0 [c]
Long-Term Stewardship	1,500	8,000	0	8,000	8,000
Total, Science and Technology	229,766 [a]	254,654 [d]	(2,542)	252,112 [d]	196,000 [d]

Public Law Authorizations:

Public Law 102-579, “Waste Isolation Pilot Plant Land Withdrawal Act (1992)”

Public Law 106-377, “The Energy and Water Development Appropriations Act, 2001"

Public Law 95-91, “Department of Energy Organization Act (1997)”

---

[a] Excludes $4,424,000 ($3,659,000 for Technology Development and $765,000 for Science Program) transferred to DOE Office of Science for award and administration of grants to small businesses.

[b] Includes Small Business Innovative Research assessment in the amounts of $925,000 in FY 2001 and $765,000 in FY 2002.

[c] For comparability purposes, the Risk Policy Program is included within the Chicago Non-Defense Site Project Completion account.

[d] Final distribution of funds by program category in FY 2001 and FY 2002 could change based upon changing priorities, and final receipt, review and selection, and award of technical proposals.

(dollars in thousands)

FY 2000 Comparable Appropriation	FY 2001 Original Appropriation	FY 2001 Adjustments	FY 2001 Comparable Appropriation	FY 2002 Request

Public Law 103-62, “Government Performance Results Act of 1993"

Public Law 106-398, “The National Defense Authorization Act for Fiscal Year 2001"

Funding by Site

(dollars in thousands)

	FY 2000	FY 2001	FY 2002	$ Change	% Change
Albuquerque Operations Office					
Los Alamos National Laboratory (NM)	6,924	5,943	2,538	-3,405	-57.3%
Sandia National Laboratory (NM)	6,716	6,599	3,368	-3,231	-49.0%
Lovelace Biomedical and Environmental Research Institute (CO)	0	0	0	0	<999.9%
Mid-West Research Institute (CO)	0	0	0	0	<999.9%
Albuquerque Operations Office (NM)	1,581	3,222	8,619	5,397	167.5%
University Robotics Program (ALO)	4,000	4,350	2,500	-1,850	-42.5%
Total, Albuquerque Operations Office	19,221	20,114	17,025	-3,089	-15.4%
Carlsbad Area Office					
Carlsbad Area Office	0	150	0	-150	-100.0%
Chicago Operations Office					
Ames Laboratory (IA)	628	533	250	-283	-53.1%
Argonne National Laboratory (West) (ID)	2,983	3,142	400	-2,742	-87.3%
Brookhaven National Laboratory (NY)	2,705	1,018	770	-248	-24.4%
Chicago Operations Office (IL)	2,424	2,952	3,590	638	21.6%
Total, Chicago Operations Office	8,740	7,645	5,010	-2,635	-34.5%
Idaho Operations Office					
Idaho National Engineering and Environmental Laboratory (ID)	49,338	40,566	18,407	-22,159	-54.6%
Grand Junction Project Office (CO)	165	121	0	-121	-100.0%
Idaho Operations Office (ID)	14,195 [a]	24,230 [a]	26,755 [a]	2,525	10.4%
Total, Idaho Operations Office	63,698	64,917	45,162	-19,755	-30.4%
National Energy Technology Laboratory (NETL)					
West Virginia	25,240	37,889	32,128	-5,761	-15.2%
University Programs (WV)	15,132	14,625	9,400	-5,225	-35.7%
Western Environmental Technology Office	10,957	6,764	0	-6,764	-100.0%
Total, National Energy Technology Laboratory (NETL)	51,329	59,278	41,528	-17,750	-29.9%
Nevada Operations Office					

[a] Includes EM Science program funding.

(dollars in thousands)

	FY 2000	FY 2001	FY 2002	$ Change	% Change
Nevada Operations Office (NV)	2,085	3,123	2,429	-694	3.6%
Oak Ridge Operations Office					
Oak Ridge Operations Office (TN)	21,358	20,287	10,695	-9,592	-47.3%
Oakland Operations Office					
Lawrence Berkeley National Laboratory (CA)	1,736	2,678	1,731	-947	-35.4%
Lawrence Livermore National Laboratory (CA)	1,097	1,319	910	-409	-31.0%
Oakland Operations Office (CA)	2,764	290	665	375	129.3%
Total, Oakland Operations Office	5,597	4,287	3,306	-981	-22.9%
Ohio Operations Office					
Fernald Environmental Management Project (OH)	3,817	2,625	255	-2,370	-90.3%
Columbus Environmental Management Project (OH)	540	0	0	0	<999.9%
Mound (OH)	2,775	920	0	-920	-100.0%
West Valley (NY)	1,845	1,005	1,810	805	80.1%
Ohio Operations Office (OH)	125	945	220	-725	-76.7%
Total, Ohio Operations Office	9,102	5,495	2,285	-3,210	-58.4%
Richland Operations Office					
Pacific Northwest National Laboratory (WA)	15,576	17,276	13,420	-3,856	-22.3%
Richland Operations Office (WA)	4,508	9,162	23,424	14,262	155.7%
Total, Richland Operations Office	20,084	26,438	36,844	10,406	39.4%
Rocky Flats Office					
Kaiser Hill (CO)	7,065	5,010	3,000	-2,010	-40.1%
Savannah River Operations Office					
Savannah River Site (SC)	16,537	16,521	15,126	-1,395	-8.4%
Savannah River Operations Office (SC)	660	5,227	2,400	-2,827	-54.1%
Total, Savannah River Operations Office	17,197	21,748	17,526	-4,222	-19.4%
Headquarters					
Washington, D.C.	4,290	13,620 [a]	11,190 [a]	-2,430	-17.8%

[a] Includes $4,648,000 in FY 2001 and $2,265,000 in FY 2002 for Small Business Research assessment.

(dollars in thousands)

	FY 2000	FY 2001	FY 2002	$ Change	% Change
Subtotal, Science and Technology	229,766 [b]	252,112 [c]	196,000 [c]	-56,112	-22.3%

[a] Excludes $4,424,000 transferred to DOE Office of Science for award and administration of grants to small businesses.

[b] Final distribution of funds by site in FY 2001 and FY 2002 could change based upon changing priorities, and final receipt, review, selection and award of technical proposals.

Radioactive Tank Waste Remediation Focus Area

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Radioactive Tank Waste Remediation Focus Area is to deliver integrated technical solutions that enable tank waste remediation to be successful across the DOE complex. To do this, the Radioactive Tank Waste Remediation Focus Area:

- Brings together users and technical experts to define and execute the mission.
- Integrates the work across the DOE complex and other funding organizations.
- Builds teams of users and providers to deliver and deploy technical solutions.

Program Goal

Over 280 large radioactive waste storage tanks and numerous other miscellaneous underground storage tanks across the DOE complex contain over 90 million gallons of radioactive waste. Most of these tanks have exceeded their design life and represent significant occupational and public risks. Current site tank remediation baselines include costly technologies and processes, pose significant programmatic and safety risks, and contain critical science and technology gaps. Using an integrated approach, the goal of the Radioactive Tank Waste Remediation Focus Area is to systematically manage the development and facilitate the deployment of science and technology to safely and efficiently achieve tank waste remediation across the DOE complex. Accomplishment of this goal will support closure of tank farms complex-wide while minimizing life-cycle costs.

Program Objectives

The objective of this Focus Area is to address the technical needs identified for management of high-level waste and closure of tanks by the Site Technology Coordination Groups. These needs have been incorporated in the EM sites' baseline planning strategy. Tank Waste Remediation Focus Area activities have progressed from early-stage technology development to advanced, fully deployable systems and implementation of key process data. This work is being accomplished in close partnership with users and with the continual participation of tribal governments, regulators, and stakeholders.

Significant Accomplishments and Program Shifts

- Demonstrate in FY 2002, pilot plant grouting technology developed by the Idaho National Engineering and Environmental Laboratory and AEA Technology for treatment of low activity waste.
- Demonstrate and deploy in FY 2001, tank waste retrieval technologies enabling continued processing plant feed delivery and tank closure activities at Savannah River Site, West Valley Demonstration Project, and Hanford Site.
- Deploy in FY 2002, regenerable high-efficiency particulate air filter technology at Savannah River Site to reduce costs and safety and health risks in tank farm operations.
- Demonstrate in FY 2000 and FY 2001, alternative salt processing technologies for Savannah River Site to support down selection and design of the replacement for In-Tank Precipitation.
- Demonstrate in FY 2001 and FY 2002, mechanical methods for pipeline unplugging to reduce risks of waste retrieval and transfer at the Savannah River Site, Hanford Site, and Oak Ridge Reservation.
- In FY 2001, demonstrate and develop recommendations for design of next generation melter at Savannah River Site and the high-level waste melter for Idaho National Engineering and Environmental Laboratory to reduce costs of processing and enable system design.
- In FY 2002, provide research and development for initiation of pilot plant operations to support the Savannah River Site Salt Processing Project.
- Deploy in FY 2001, remote technology enhancements for tank farm valve pit operations to reduce safety risks and support waste treatment at Hanford.
- Demonstrate in FY 2002, grouting of low activity waste at the Idaho National Engineering and Environmental Laboratory.

Funding Schedule

(Dollars in Thousands)

	FY 2000	FY 2001	FY 2002
Tank Waste Retrieval and Closure	18,200	23,583	26,940
Tank Waste Pretreatment and Immobilization	25,682	31,975	28,885
Total, Radioactive Tank Waste Remediation Focus Area	43,882	55,558	55,825

Detailed Program Justification

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Tank Waste Retrieval and Closure 18,200 23,583 26,940

The Savannah River Site, Hanford Site, Idaho National Engineering and Environmental Laboratory (Idaho), Oak Ridge Reservation, and West Valley Demonstration Project require technical assistance, technology development, and baseline technology performance verification to improve efficiency, reduce costs and risks, and enable baseline tank waste retrieval and closure systems to be implemented. Each of these sites is at a different stage in the retrieval of wastes and closure of tanks. Oak Ridge and West Valley have retrieved the majority of the bulk wastes and are focused on residuals removal and tank closure. Savannah River is continuing sludge and heel retrieval to feed the Defense Waste Processing Facility and to continue tank closures. Hanford is preparing for waste retrieval to support feed delivery to a planned processing facility, while Idaho is focused on waste residuals to support an accelerated schedule for tank closure and retrieval evaluation for calcine disposition.

Within the Tank Waste Retrieval and Closure Product Line, more cost effective and efficient methods to mobilize and retrieve sludges and ensure continued feed delivery will be deployed. Pipeline unblocking tools will be demonstrated to reduce the risks of blocked waste transfer lines and interruptions in feed delivery. Improved sampling and analysis systems for retrieved wastes will be developed. Heel retrieval and tank cleaning systems will be developed and deployed to enable tank closure. Tank farm operational improvements, including tank ventilation, tank integrity inspection, pump pit maintenance, and tank corrosion monitoring systems, will be deployed to reduce costs and risks of tank farm operations that support the retrieval and safe waste storage operations. To reduce the risks of future leaks to the vadose zone and to enable retrieval from single-shell tanks, a leak mitigation system will be developed. Future processing will require retrieval of currently stored calcine wastes at Idaho. Methods for dry retrieval of calcine will be identified and tested to establish a baseline for future processing decisions. Grout formulation development and residual waste sampling will be pursued to support increasing tank closure activities across the sites. Retrieval systems will be developed and deployed for small horizontal tanks, and stabilization methods will be deployed for grouting and closure of tanks.

In FY 2002, there are five work elements that support this product line: 1) Transfer Line Unplugging/Feed Stability; 2) Waste Immobilization and Retrieval; 3) Tank Integrity and Heel Retrieval; 4) Ancillary Tank Equipment Enhancements; and 5) Tank Closure. Planned activities include:

Demonstrate a Small Tank and Piping Retrieval System to support West Valley's initial campaigns to clean and close tanks.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

- # Demonstrate equipment improvements for tank waste retrieval to reduce safety risks and meet waste remediation schedules at Hanford.
- # Demonstrate transfer piping photographic inspection system at Savannah River.
- # Demonstrate a Non-Destructive Evaluation system for double-shell tank inspection at Hanford to ensure safe waste storage and waste transfer operations.
- # Deploy a Sludge Mapping and Tank Inspection System for Melton Valley Storage Tanks at Oak Ridge to support privatization schedules at Oak Ridge.
- # Conclude preliminary investigations on chemical cleaning techniques supporting tank closure at the Savannah River Site.

Tank Waste Pretreatment and Immobilization 25,682 31,975 28,885

The Savannah River Site, Hanford Site, Idaho National Engineering and Environmental Laboratory (Idaho), Oak Ridge Reservation, and the West Valley Demonstration Project require technical assistance, technology development, and baseline process performance verification to improve process efficiency, reduce costs and risks, meet regulatory schedules, and enable baseline tank waste processing systems to be implemented. Savannah River must downselect a technology alternative for salt processing to proceed with design activities and also maintain the Defense Waste Processing Facility operations and improve through-put to meet canister production requirements; Hanford must prepare for waste feed delivery to a processing facility; Idaho must continue development and testing to implement the Record of Decision for waste treatment and meet Title I design schedule. Finally, Oak Ridge must continue to prepare for treatment of tank wastes through a privatization contract. Each of these sites is at a different stage in the processing of radioactive tank wastes.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Within the Tank Waste Pretreatment and Immobilization Product Line, melter improvements, including pour spout design changes, improved waste loading in glass, and next generation melter technology to increase throughput and melter life, will be pursued to improve Defense Waste Processing Facility operations; support the Idaho National Engineering and Environmental Laboratory calcine treatment decisions; and support future Hanford waste processing cost and risk reduction. Process additions and improvements in remote technology for maintenance and decontamination activities within the Savannah River melter facility will also be addressed to improve process efficiencies and reduce costs. Also at Savannah River, a salt processing technology alternative is required to enable future processing and immobilization of the salt wastes. Pilot-scale demonstration of the preferred salt disposition alternative will be performed to meet baseline project design requirements and avoid the cost impacts of further delays to immobilization operations with salt feed. At Hanford, waste solution chemistry studies and slurry monitoring development will be performed to reduce the risks of unwanted solids during waste retrieval, waste transfer and feed delivery operations. Sludge washing and dissolution testing will also be conducted to support design and operations of future waste processing plant. In addition, long term glass performance testing will be performed to support disposal system design for low activity waste. At Idaho, treatment process development will focus on implementation of the Record of Decision. Activities will include integrated flowsheet development, radionuclide separations testing, and grout and glass immobilization testing. In addition, Idaho must meet new consent order requirements for reduction of newly generated tank wastes. Remote and process technology will be developed and deployed at West Valley to enable decontamination and disposal of process equipment. A canister decontamination system will be implemented to enable offsite transportation.

In FY 2002, there are four work elements that support this product line: 1) Enhanced Immobilization Productivity; 2) Product Acceptance and Canister Storage; 3) Solids Pretreatment; and 4) Radionuclide Removal. Planned activities include:

- Deploy improved decommissioning and decontamination equipment for vitrification expended materials at West Valley to avoid costly storage of contaminated equipment.
- Deploy an improved frit tailored to sludge only operation at Savannah River’s Defense Waste Processing Facility to provide better performance through foam reduction.
- Demonstrate performance of low activity waste glass composition region for Hanford to improve confidence that vendors' waste forms meet contract and performance requirements.
- Recommend operating envelopes for pipeline waste transfer at Savannah River and Hanford to reduce the risks of pipeline plugging during waste retrieval and transfer.
- Provide research and development support for the initiation of pilot plant operations to support the Savannah River Site Salt Processing Project.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Demonstrate grouting of low activity waste at the Idaho National Engineering and Environmental Laboratory.

Total, Radioactive Tank Waste Remediation Focus Area	43,882	55,558	55,825

Explanation of Funding Changes from FY 2001 to FY 2002

	FY 2002 vs. FY 2001 ($000)
Tank Waste Retrieval and Closure	
# Increase due to additional emphasis on tank waste mixing and retrieval through improvements in mixer and mixer pump technologies; increased development of tank integrity inspection technologies through procurement of a remote tank repair system for the Savannah River Site; and further technology development related to tank integrity inspection supporting the Idaho National Engineering and Environmental Laboratory, Hanford, Oak Ridge Reservation, West Valley, and Savannah River Sites	3,357
Tank Waste Pretreatment and Immobilization	
# Decrease due to decreased emphasis of technology development efforts related to immobilization of tank waste	-3,090
Total Funding Change, Radioactive Tank Waste Remediation Focus Area	267

Subsurface Contaminants Focus Area

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Subsurface Contaminants Focus Area is to provide environmental stewards with technical solutions for their subsurface contamination problems.

Program Goal

The Subsurface Contaminants Focus Area develops, demonstrates, and deploys innovative technology solutions and provides technical assistance as required to solve end user soil and groundwater problems. These innovative solutions satisfy state and Federal regulatory compliance requirements, reduce health and safety risks, and verify the long-term effectiveness of all remediation activities.

The Subsurface Contaminants Focus Area also employs partnerships with other EM programs, other Federal agencies, and the international community to assure the broadest resources are applied to provide technologies and technical assistance to end-users to achieve cleanup goals and to conduct long-term monitoring of soils and groundwater at DOE sites.

Program Objectives

Across the DOE complex, over 5,000 plumes contaminate more than 40 million m^3 of soil and 1.7 trillion gallons of ground water with volatile organic compounds, dense non-aqueous phase liquids, hazardous metals, and radionuclides. Approximately three million m^3 of solid radioactive and hazardous wastes buried in landfills and trenches must be contained so that they do not leach and further contaminate soil and ground water. The contaminants pose significant health and safety risks and are present at all DOE sites, located at various depths in the vadose and saturated zones. In order to meet the EM sites' baseline planning goals and Federal and state compliance laws, cleanup must be accelerated and cleanup costs reduced.

The objective of the Subsurface Contaminants Focus Area is to provide solutions that address difficult remediation problem areas identified by the Site Technology Coordination Groups. The Focus Area implements this program in an integrated manner with other Federal agencies, industry, national labs, and universities to provide faster cleanup and lower cost to the taxpayer. The Subsurface Contaminants Focus Area is coordinating vadose zone research efforts with all DOE Operations Offices, especially Richland in their efforts for remediation of contaminants under the high-level waste tanks.

Significant Accomplishments and Program Shifts

- Complete in FY 2001, Phase II multi-Federal agency demonstration for the removal of Dense Non-Aqueous Phase Liquids contamination from soil at Cape Canaveral using heating technologies and oxidative destruction. Successful demonstration of these technologies will reduce cleanup of Dense Non-Aqueous Phase Liquid contaminated sites from tens of years to a few years.
- Continue in FY 2001, technology development efforts, in cooperation with the Environmental Protection Agency, to improve landfill caps, covers and barriers to prevent the migration of wastes from DOE sites. The Environmental Protection Agency is incorporating the data from these successful demonstrations into national landfill cover design guidance.
- Demonstrate in FY 2001, Dense Non-Aqueous Phase Liquid detection at depth and/or difficult settings to support remediation at Hanford and Oak Ridge.
- Complete in FY 2001, in-situ vitrification at Los Alamos National laboratory to treat highly radioactive and/or high concentration source areas. This process will demonstrate that in-situ vitrification is a safe and viable technology for the destruction of organic material and stabilization of metals and radionuclides in the soil.
- Deploy in FY 2001, an advanced tensiometer at Hanford tank farm to accurately measure the amount and direction of groundwater flow to determine contaminant migration from tanks.
- Demonstrate in FY 2001, one long-term stewardship technology at Fernald to enable remote automated monitoring of the integrity of the leachate collection system of the onsite disposal facility.
- Deploy, in FY 2002, improved arid landfill cover design and monitoring system at Nevada. Reliable regulator approved capping of closed landfills will be essential in meeting site closure dates.
- Deploy, in FY 2002, High Resolution Borehole Seismic imaging for mapping dense non-aqueous phase liquids contamination and transport at Pinellas and Idaho. This non-intrusive technology for Dense Non-Aqueous Phase Liquid detection does not require drilling or costly laboratory analysis.
- Demonstrate, in FY 2001, Through Casing Resistivity Tomography at the Hanford tank farm to identify moisture zones beneath tanks which may affect contaminant migration.
- Demonstrate, in FY 2002, Novel Hotpoint Dense Non-Aqueous Phase Liquids detector at a competitively selected site. This technology enables more accurate detection and removal of Dense Non-Aqueous Phase Liquid source terms to prevent or halt formation of dilute plumes.

Funding Schedule

	FY 2000	FY 2001	FY 2002
Dense Non-Aqueous Phase Liquids	16,352	10,875	13,650
Source Term Containment/Source Term Remediation	11,011	15,177	8,321
Metals and Radionuclides in the Vadose and Saturated Zones	14,145	14,677	10,494
Total, Subsurface Contaminants Focus Area	41,508	40,729	32,465

Detailed Program Justification

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Dense Non-Aqueous Phase Liquids 16,352 10,875 13,650

All major DOE sites have difficulty remediating groundwater contamination resulting from the discharge into the soil of toxic and carcinogenic organic solvents termed Dense Non-Aqueous Phase Liquids. Dense Non-Aqueous Phase Liquids are difficult to locate, and even in small quantities, create large contaminated groundwater plumes. The dense nature and low solubility of these compounds allow them to move downward through the vadose zone and groundwater and to spread laterally along low permeability layers forming disseminated pools, which slowly contaminate groundwater. No technology exists to cost effectively locate Dense Non-Aqueous Phase Liquids sources. Therefore, pump-and-treat, or other costly, ineffective and time consuming treatment systems must be used to maintain compliance for many cleanup projects. In some hydrogeologic settings, it is not practical to install pumping systems. Focus will be on the development of technologies and methods to locate and quantify Dense Non-Aqueous Phase Liquids sources, treat the contaminated groundwater and soils in-situ to reduce cleanup mortgages while enabling cost-effective cleanup. Virtually every field office site across the complex has a need for improved analytical tools and in-situ monitoring devices that eliminate the need to retrieve and transport samples. Dense Non-Aqueous Phase Liquid activities, including innovative characterization technologies, reactive barrier technologies, bioremediation, and in-situ thermal chemical destruction will be demonstrated in cooperation with other federal agencies and in international initiatives. Both DOE national laboratories and private industry will be engaged to improve contaminant characterization and delineation in the vadose zone and deep and complex geologic settings.

In FY 2002, there are three distinct work elements which support this Product Line: 1.) Characterization, Monitoring, Modeling and Analysis for Dense Non-Aqueous Phase Liquids; 2.) Saturated Zone Treatment Systems Targeted for Dense Non-Aqueous Phase Liquids; and 3.) Access and Delivery Systems for Dense Non-Aqueous Phase Liquids. Planned activities include:

- Deploy High Resolution Borehole Seismic imaging for mapping dense non-aqueous phase liquids contamination and transport at Pinellas and Idaho.
- Demonstrate Novel Hotpoint Dense Non-Aqueous Phase Liquids detector.
- Deploy methods for difficult dense non-aqueous phase liquids detection under a building at the Hanford Carbon Tetrachloride plume.
- Deploy soil characterization Off-Surface Sensor for Cone Penetrometer.
- Deploy improved dense non-aqueous phase liquids detection at depth at Hanford and Oak Ridge.
- Deploy dense non-aqueous phase liquids treatment in fractured rock at Oak Ridge.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

- # Demonstrate dense non-aqueous phase liquids treatment in deep/difficult settings at Paducah, Oak Ridge and Hanford.
- # Deploy treatment processes to remediate dense non-aqueous phase liquids in deep/difficult setting using industry-supplied access and placement technologies at Interagency Site.

Source Term Containment/Source Term Remediation 11,011 15,177 8,321

DOE spends a large part of its resources on monitoring and maintaining leaking radioactive and mixed waste landfills to achieve compliance with regulatory requirements. Many of the landfill containment systems currently deployed in arid environments, built to current regulatory specifications, are failing and will require costly repair, maintenance or replacement. Improved long-term cover system designs are required for arid climates to correct this situation and support long-term stewardship goals. Currently, verification and monitoring systems exist only for newly constructed engineered landfills. Additionally, the emplacement of barriers at significant depths has not been accomplished. Current remediation actions do not utilize deep-placement technologies, and programs often opt to implement more costly solutions. Also, engineered landfills do not address the gap between short-term activities and long-term stewardship.

The development of improved verification and monitoring systems to evaluate both the construction and performance of barrier systems will improve barrier performance, reduce the life-cycle cost of containment, and support long-term stewardship solutions that address stakeholder concerns. In addition, advanced integrated verification and monitoring systems and architecture will begin to focus on the need for reliable, robust, cost effective verification and monitoring solutions. Better caps, covers and barriers are needed to prevent the migration of the unique DOE disposed wastes and development of improved equipment and systems for long-term stewardship is needed to understand performance of materials and systems, reduce uncertainties, and bridge the technology gap between short-term activities and long-term stewardship.

A landfill closure design guidance to maximize design life for application across the complex is required. To that end, an improved understanding of the performance of containment materials and systems is required to reduce uncertainties and bridge the gap between short-term activities and long-term stewardship. These solutions will reduce the risk of contaminant migration in the environment, speed cleanup, and facilitate safer cleanup, and support science and technology requirements associated with long-term stewardship. All this serves to reduce risk to the public and site workers as well as reduce environmental degradation.

In FY 2002, there are three distinct work elements which support this Product Line: 1.) Characterization, Monitoring, Modeling and Analysis; 2.) Saturated Zone Treatment Systems; and 3.) Validation, Verification and Long-term Monitoring of Containment and Treatment. Planned activities include:

- # Deploy alternative landfill cover design and monitoring system at Nevada.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

- # Demonstrate remote sensing for long term monitoring at Savannah River.
- # Demonstrate in situ systems for long term monitoring.
- # Demonstrate electrical methods to evaluate and monitor geomembrane caps at multiple sites.

Metals and Radionuclides in the Vadose and Saturated Zones **14,145** **14,677** **10,494**

Metal and radionuclide contamination is present in the vadose and saturated zones at all DOE Sites. Current technologies for the treatment of metals and radionuclides typically include excavation followed by ex-situ treatment and/or disposal, or pump-and-treat. These methods are costly, inefficient, and involve risk to workers. In addition, in many cases, they are inadequate to attain EM sites' baseline planning goals.

To effectively address the existing site needs, solutions must be developed that reduce or eliminate the volume of secondary waste, minimize workers' exposure, and reduce risk to the environment. Improved methods for sampling, delivery of treatment chemicals, or contaminant removal will be demonstrated at Richland and the Nevada Test Site. In situ methods to assess metals and radionuclide contaminants will be developed and demonstrated at Richland, Fernald, Nevada Test Site and Lawrence Livermore National Laboratory.

Existing access, sampling, and delivery methods cannot place characterization and treatment technologies in DOE's deep and difficult geologic settings. These sites will be the most costly to remediate due to contaminant depth and geologic complexity. Improved technologies are needed to address contaminants under these conditions.

In FY 2002, there are four distinct work elements which support this Product Line: 1.) Characterization, Monitoring, Modeling and Analysis for Metals and Radionuclides; 2.) Vadose Zone Treatment Systems Targeted for Metals and Radionuclides; 3.) Saturated Zone Treatment Systems Targeted for Metals and Radionuclides; and 4.) Validation, Verification and Long-term Monitoring of Containment and Treatment for Metals and Radionuclides. Planned activities include:

- # Demonstrate in situ Tritium monitoring in difficult conditions at Nevada and Oakland.
- # Demonstrate in situ detection of metals and radionuclides in the vadose zone at Hanford and Fernald.
- # Demonstrate remediation of radionuclides in the vadose zone at Hanford and Nevada.
- # Develop multi-scale, 3-D transient contaminant transport models for application at Hanford.
- # Demonstrate remediation of metals and radionuclides using treatment zones at Richland 100 Area.

Total, Subsurface Contaminants Focus Area	41,508	40,729	32,465

Explanation of Changes from FY 2001 to FY 2002

	FY 2002 vs. FY 2001 ($000)
Dense Non-Aqueous Phase Liquids	
# The increase is related to completion of significant work in FY 2001 and a shift in activities to address more difficult problems. With the completion of FY 2001 work, performed primarily in the relatively simple environment of unconsolidated sediments, the focus is shifting to more difficult and deeper environments. The FY 2002 work is more complicated and expensive than previous efforts.	2,775
Source Term Containment/Source Term Remediation	
# Due to the need to address higher priority requirements identified by EM sites, some technology development activities related to long-lived caps and subsurface containment systems will not be initiated in FY 2002	-6,856
Metals and Radionuclides in the Vadose and Saturated Zones	
# Decrease due to completion, in FY 2001, of several deployment projects. In addition, because of the need to address higher priority requirements identified by EM sites, some technology development activities related to characterization, chemical treatment, barrier, monitoring and verification systems will not be initiated	-4,183
Total Funding Change, Subsurface Contaminants Focus Area	-8,264

Transuranic and Mixed Waste Focus Area

Mission Supporting Goals and Objectives

Program Mission

The mission of the Transuranic and Mixed Waste Focus Area is to invest in cutting-edge technical and engineering solutions for transuranic and mixed waste characterization and processing for shipment and disposal. This focus area responds to customer critical closure pathway and waste stream disposition goals from initial needs identification through technology deployment. Partnered with other Environmental Management programs, advanced technology solutions are accomplished via an end-user driven process. This process is aimed at efforts relating to mixed low-level waste and transuranic waste disposition needs as identified in the EM sites' baseline planning data.

Program Goal

The goal of the Transuranic and Mixed Waste Focus Area is to provide technical and engineering solutions to support effective, efficient transuranic and mixed waste characterization and treatment technology systems. Site treatment plans identified about 154,000 m^3 of mixed and transuranic waste in storage that includes over 754 mixed waste streams.

Program Objectives

The objective of the Transuranic and Mixed Waste Focus Area is to develop technologies that address the mixed low-level and mixed transuranic waste needs identified by the Site Technology Coordination Groups and that have been incorporated in the sites' baseline planning strategy. Having developed and assessed several primary mixed waste treatment systems, the current Transuranic and Mixed Waste Focus Area strategy emphasizes development and deployment of enabling technologies to assist the Department in meeting its mixed waste schedule commitments to regulators and the public. This focus area will assist in the deployment of alternative technologies at individual sites to achieve cost effective characterization for shipment to the Waste Isolation Pilot Plant of transuranic waste and characterization and processing of mixed transuranic and low-level waste to achieve final disposition.

Significant Accomplishments and Program Shifts

- Completed in FY 2000, demonstration of HANDS-55 drum opening module, making the module available for deployment at the Savannah River Site and Los Alamos National Laboratory. HANDS-55 is a transuranic waste repackaging system that remotely opens 55 gallon drums, removes non-compliant items and repackages the waste for transfer to the Waste Isolation Pilot Plant.
- Completed in FY 2000, remote handled transuranic waste gas generation rate solution/matrix depletion demonstrations to support the Idaho National Engineering and Environmental Laboratory, the Los Alamos National Laboratory, and the Savannah River Site in meeting the Waste Isolation Pilot Plant transportation requirements.
- Completed in FY 2000, a phosphate-based demonstration at Hanford's Effluent Treatment Facility to provide a deployable low temperature stabilization process for the site's Effluent Treatment Facility residues.
- Deploy, in FY 2001, the ATG GasVit system at Hanford to treat organic mixed waste so it can be disposed without incineration.
- In FY 2002, deploy a particulate matter Continuous Emissions Monitor at the Oak Ridge Toxic Substance Control Act Incinerator to enable operation through 2003 under the Maximum Achievable Control Technology compliance rule.
- Completed, in FY 2000, the National Initiative supporting Oak Ridge's Balance of Inventory process to enable the treatment of elemental mercury wastes from across the DOE complex.
- Complete, in FY 2002, final demonstration and begin preparation for deployment of HANDSS-55 repackaging system at the Savannah River Site.
- Completed, in FY 2000, demonstration of the Transuranic Optimized Measurement System. Deployment at Savannah River in FY 2001 will allow the site to assay and segregate non-transuranic and transuranic waste to lower disposal costs.
- Complete, in FY 2001, demonstration of a technology that reduces the number of confinement layers in transuranic waste drums. This technology solution allows more waste to be placed in each drum without first treating or repackaging, thus reducing disposal costs and risk to workers safety.
- Complete, in FY 2002, the deployment of a polymer filtration system for removing mercury contaminant from organic waste streams at Oak Ridge allowing disposal as low level waste thus lowering disposal costs.
- Complete, in FY 2002, the demonstration of the Integrated Box Interrogation System at the Idaho National Engineering and Environmental Laboratory on site waste.
- Complete, in FY 2002, startup demonstration of an Alternative Oxidation Technology method for treatment of Plutonium-238 job-control waste at the Savannah River Site to enable shipment of waste to the Waste Isolation Pilot Plant and to meet Savannah Rivers shipment schedules.

- # Complete, in FY 2002, demonstration of Hydrogen Gas Getters at Savannah River, Idaho National Engineering and Environmental Laboratory and Los Alamos National Laboratory. These demonstrations will provide an inexpensive means of reducing the flammable gas concentrations in drums of waste to be shipped to the Waste Isolation Pilot Plant. This process (Hydrogen Gas Getters) enables meeting the limits set forth in the TRUPACT-II Safety Analysis Report and allows larger amounts of waste to be contained in each drum reducing disposal costs.

- # DOE has announced plans to suspend radioactive and mixed waste incineration at Savannah River for at least five years, and to stop incineration of these wastes at the Idaho National Engineering and Environmental Laboratory and Oak Ridge in 2000 and 2003, respectively. More stringent air emissions standards, which have been recently promulgated, would require significant, and costly, upgrades to DOE's incinerators. Their relatively high volumes of off-gas emissions make their permitting and public acceptability more difficult to achieve. DOE's incineration capacity will be severely limited over the next five years and, perhaps, permanently eliminated. These considerations drive needs for alternatives to incineration's open-flame oxidation process in order to meet regulatory treatment standards in compliance with consent orders and other agency agreements. The Science and Technology program must provide those alternatives in time to avert major negative impacts to site cleanup goals. In FY 2002, development of technology alternatives will be continued within the Transuranic and Mixed Waste Focus Area consistent with recommendations resulting from the Secretarial-commissioned Blue Ribbon Panel on Emerging Technological Alternatives to Incineration.

Funding Schedule

	FY 2000	FY 2001	FY 2002
Transuranic Waste Handling and Characterization	10,532	15,735	11,456
Mixed Transuranic and Mixed Low-Level Waste Treatment Alternatives	17,535	16,135	11,611
Total, Transuranic and Mixed Waste Focus Area	28,067	31,870	23,067

Detailed Program Justification

(dollars in thousands)

	FY 2000	FY 2001	FY 2002
Transuranic Waste Handling and Characterization	**10,532**	**15,735**	**11,456**

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Characterization development activities will focus on supporting the development and deployment of technology solutions that can improve the end-user's capacity to non-destructively examine and assay containerized waste, allowing workers to safely identify and quantify radioactive and hazardous components. Current characterization development activities focus on deployment of improved methods for characterizing radionuclides in low activity, contact-handled waste drums. Further development is needed regarding enabling technologies to characterize radionuclides in contact-handled boxes and remote-handled wastes.

Technology solutions to address boxes will use basic techniques developed for 55-gallon drums. Application of such techniques to larger box size waste containers is not easily accomplished using a simple scaling technique, and presents additional complications to established methods. Techniques need to be developed to account for waste-form-dependent radiation transport. Inconsistencies induced by the waste-form attributes of these large volume configurations are inevitable. There is a critical need for non-destructive analysis technology for remote-handled waste types. Development, demonstration and deployment of non-destructive analysis techniques to reduce pre-characterization costs and optimize mixed waste treatment operations are planned.

Transportation related activities focus on increasing the payload efficiency of transuranic waste shipments by addressing hydrogen gas generation and buildup issues. Hydrogen gas generation is caused by the radiolysis of hydrogenous waste packaging and materials. The Nuclear Regulatory Commission is concerned with the potential for fire or explosion during transport periods and therefore places restrictions on the contact-handled and remote-handled transuranic wastes that can be shipped using the TRUPACT-II and 72B casks.

Transuranic Waste material handling activities focus on improving the end-users capability to remotely handle highly radioactive waste streams during sizing, repackaging and transport operations. Due to the hazards associated with these wastes, advanced remote handling systems are needed to improve safety and efficiency of operations. A transuranic waste repackaging system will be developed and deployed at the Savannah River Site. This system remotely opens 55-gallon drums, removes non-compliant items and repackages the waste for transfer to the Waste Isolation Pilot Plant. This technology is being fully automated and adapted to a mobile platform to solve the remote-handled repackaging needs of many DOE sites. Several sites have large volumes of waste that must be size-reduced before disposal. The Transuranic and Mixed Waste Focus Area is developing remotely operable systems to size-reduce and segregate transuranic waste from low-level waste to better utilize existing disposal areas.

In FY 2002, there are three work elements which support the Transuranic Waste Handling and Characterization Product Line: 1.) Non-Destructive Characterization of Mixed Low-Level Waste and Transuranic Waste; 2.) Payload Enhancement for Transportation of Transuranic Waste; and 3.) Mixed Low-Level Waste And Transuranic Material Handling. Planned activities include:

Demonstrate the Integrated Box Interrogation System at the Idaho National Engineering and Environmental Laboratory on waste types selected in FY 2001.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

- # Complete demonstration and begin the deployment of HANDSS-55 repackaging system at the Savannah River Site.
- # Demonstrate advanced Hydrogen Gas Getters concepts that will meet the stated performance requirements that will be included in Revision 20 of the TRUPACT-II Safety Analysis Report. This will support the transportation of transuranic waste at the Idaho National Engineering and Environmental Laboratory, Savannah River Site, Hanford, and Los Alamos National Laboratory.

Mixed Transuranic and Mixed Low-Level Waste Treatment Alternatives 17,535 16,135 11,611

The Department's mixed waste inventory contains hazardous organic materials that are difficult to stabilize. Therefore, oxidation of organic material prior to final treatment is advantageous. The presence of certain volatile substances (e.g. mercury, actinides, tritium) in the waste eliminates incineration as an oxidation method. In addition, incineration is not accessible to all DOE sites. These considerations drive needs for alternative lower-temperature methods to oxidize organic materials. Transuranic mixed wastes containing organics also require alternative oxidation technologies.

Mercury is present in a broad range of concentrations in several of the DOE's mixed waste streams. Because it is highly mobile and easily vaporized, the presence of mercury complicates designing off-gas systems, stabilizing treatment residues, and monitoring all effluents. Removing mercury before treatment would significantly simplify downstream treatment operations, thereby reducing the cost of treatment facility design, construction, and operation risks. The separated mercury must then be amalgamated, or otherwise stabilized for disposal as a separate waste stream. The Environmental Protection Agency specifies different treatments for mercury-contaminated wastes depending on the concentration of mercury in the waste matrix. Currently, there are no processes applicable to large scale radioactive environments which will produce a waste form which complies with stringent Environmental Protection Agency disposal requirements.

Portland cement is the baseline low-temperature stabilization technology currently used for much of the sludge, soils, and homogeneous solids that comprise the Department's mixed-low- level waste inventory. Unfortunately, cement has proven an inefficient method for many of these waste streams. These materials, in sufficient quantities, can cause premature degradation of the waste form or prevent concrete waste-forms from setting. This problem is currently rectified by mixing very low proportions of the waste material with the Portland cement, but this practice significantly increases waste volume, increasing waste handling and transportation costs and consumes scarce disposal capacity. Alternative stabilization technologies are needed. Based on a survey of site needs, technologies are also required for the micro- and macro-encapsulation of various mixed wastes in general.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

DOE has traditionally operated several thermal treatment systems. These thermal treatment systems have come under increasing pressure from an operations cost perspective. More stringent regulatory requirements, such as the Environmental Protection Agency rule for Maximum Achievable Control Technology for Hazardous Waste Combustors, and poor utilization of capacity have caused DOE to announce the closure of the Waste Experimental Reduction Facility at the Idaho National Engineering and Environmental Laboratory in 2000 and to suspend operations for five years of the Consolidated Incineration Facility at the Savannah River Site. This leaves the Toxic Substances Control Act Incinerator at the Oak Ridge Reservation as the only operating incinerator, and it must modify operations to meet the Maximum Achievable Control Technology Rule. The draft Environmental Impact Statement for the Idaho Nuclear Technology Engineering Center at the Idaho National Engineering and Environmental Laboratory includes several thermal and non-thermal treatment options for the remaining sodium bearing waste and high-level waste.

The move away from thermal treatment within the DOE complex has prompted increased interest in alternative treatment technologies. Most of these technologies are in development or are very early in their commercial phases. In addition to questions on performance over a range of potential waste feeds, there is very little hard data on effluents (either gaseous or liquid) or on the residuals from these processes. The diagnostic tools are often lacking to determine what contaminants might be present and in what amounts. Techniques to control those emissions have also not been established. Regulators have expressed concern over permitting of these units without more knowledge of these issues.

The strategy being applied to resolving the above problems has two parts. First, there must be a strategy to help existing or future thermal treatment facilities meet the Maximum Achievable Control Technology Rule or similar regulatory requirements. It will focus primarily on off-gas control and monitoring issues, which must be addressed in the next two years to meet the September 30, 2002, compliance date of the Maximum Achievable Control Technology Rule. The second part is to understand the potential environmental impacts associated with various alternatives to incineration, how regulators will permit such facilities, and what effluent control and monitoring will be required. Solutions to these issues must be identified in the next 3 to 5 years to ensure that sites can meet the consent agreement dates in their site treatment plans.

With the potential for the DOE incinerators to shut down, off-gas monitoring (Continuous Emission Monitor) development will continue and be applied to alternative treatment technology systems.

In FY 2002, three work elements support this product line: 1) Alternatives to Incineration; 2) Unique Waste Solutions; and 3) Effluent Monitoring and Control. Planned activities include:

- Complete installation and startup of an Alternative Oxidation Technology method or an alternative decontamination process for treatment of the Savannah River Site Plutonium-238/Transuranic job-control waste.
- Deploy polymer filtration for removing mercury from identified organic contaminated waste streams at Oak Ridge or identified commercial site.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

- # Deploy particulate matter Continuous Emission Monitor at the Oak Ridge Toxic Substance Control Act Incinerator in collaboration with the Environmental Protection Agency.
- # Through site working groups, treatability studies, waste consolidation, and privatization efforts, deploy solutions for three unique waste stream categories selected in FY 2001. Categories include mercury waste, reactives, sealed sources, and tritium contaminated waste.

Total, Transuranic and Mixed Waste Focus Area	28,067	31,870	23,067

Explanation of Funding Changes from FY 2001 to FY 2002

	FY 2002 vs. FY 2001 ($000)
Transuranic Waste Handling and Characterization	
# Due to the need to address higher priority requirements identified by the EM sites, some technology development activities related to transuranic characterization and waste repackaging will not be initiated in FY 2002	-4,279
Mixed Transuranic and Mixed Low-Level Waste Treatment Alternatives	
# Due to the need to address higher priority requirements identified by the EM sites, some technology development activities related to monitoring and control systems will not be initiated in FY 2002	-4,524
Total Funding Change, Transuranic and Mixed Waste Focus Area	-8,803

Deactivation and Decommissioning Focus Area

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Deactivation and Decommissioning Focus Area is to identify, develop, demonstrate, and assist the deployment of improved deactivation and decommissioning technology systems which reduce costs, and health and safety risks to workers, the public and the environment. The Focus Area addresses immediate and long-term needs of radioactively-contaminated surplus facilities within the DOE complex to accelerate decontamination and decommissioning schedules.

Program Goal

The primary goals of the Focus Area are the reduction of worker health and safety risk and the reduction of EM's deactivation and decommissioning mortgage by 40 percent. EM will incur one-third of the estimated $12 billion life-cycle cost for deactivation and decommissioning work before 2007. The Focus Area's goal is to reduce this pre-2007 mortgage of approximately $4 billion by $1 billion (25 percent) and the post-2006 mortgage (nearly $8 billion) by $4 billion (50 percent). DOE estimates an additional $25 billion to deactivate and decommission facilities currently owned by the DOE Offices of Nuclear Energy, Defense Programs, and Science. In FY 2002 excess Nuclear Energy/Defense Programs/Science facilities will become available for transfer to EM. Since the majority of these surplus facilities will not be transferred to EM until after 2006, the Deactivation and Decommissioning Focus Area estimates it can reduce the mortgage associated with these facilities by 40 to 50 percent resulting in a savings to DOE of $10 to $12 billion.

Program Objectives

The Deactivation and Decommissioning Focus Area supports a two-pronged strategic approach for the development, demonstration and deployment of new and innovative deactivation and decommissioning technologies. The objective of the first leg of this two-pronged approach focuses on longer-term needs that can benefit from early stage, basic science and applied research. This research, conducted by national laboratories, universities and the private sector provide the foundation for new knowledge and scientific breakthroughs that support the development of a whole new generation of safe and cost-effective deactivation and decommissioning technologies.

The second leg of the Deactivation and Decommissioning Focus Area strategic approach addresses immediate and near-term deactivation and decommissioning needs that must be met with mature technologies. The

objective is to rapidly demonstrate and validate innovative and improved deactivation and decommissioning technologies via Large-Scale Demonstration and Deployment Projects and Accelerated Site Technology Deployment projects. This approach focuses on high priority deactivation and decommissioning projects identified by and co-funded with facility owners. The Large-Scale Demonstration and Deployment Projects demonstrate full-scale innovative and improved deactivation and decommissioning technologies, beside existing baseline technologies. The purpose is to compare benefits from using a suite of innovative deactivation and decommissioning technologies against those associated with baseline technologies. The Accelerated Site Technology Deployment Projects foster widespread deployment of technologies proven superior to baseline technologies within the Large-Scale Demonstration and Deployment Projects. The primary benefit of the combined Large-Scale Demonstration and Deployment Project/Accelerated Site Technology Deployment Project approach is that technologies compared and validated against baseline technologies are rapidly incorporated as the new baseline into other deactivation and decommissioning projects at the demonstration site or at other DOE sites. Primary drivers of this work are a significant reduction in risk to workers involved in cleanup efforts, reduced costs/mortgages, and the disposition or reduction of large amounts of waste generated from deactivation and decommissioning activities.

Significant Accomplishments and Program Shifts

- In FY 2000, completed, at Savannah River, the Large-Scale Demonstration and Deployment Project for deactivation of the 321-M Highly Enriched Uranium Facility. Five to eight improved and innovative technologies were demonstrated and three were subsequently deployed to remove an estimated 1,200 grams of highly enriched uranium occupying ventilation ducts, processing systems and open surfaces. The project allows DOE to convert 9,000 square feet of existing contaminated area into a radiological buffer area with clearly identified islands of fixed contamination areas, thereby reducing ongoing surveillance and monitoring costs.
- In FY 2001, completed the Large-Scale Demonstration and Deployment Project for deactivation and decommissioning of Idaho National Engineering and Environmental Laboratory fuel storage pool and reactor facilities. Sixteen innovative technologies were demonstrated and to date, ten have been deployed for underwater inspection and equipment size reduction, surface characterization and decontamination, structural dismantlement, and fuel pool liquid treatment and sludge/debris removal.
- In FY 2000, deployed the Compact Remote Console enhanced telerobotic Remote Control Concrete Demolition System (Brokk) to dismantle facilities (e.g., Tan-620) at the Idaho National Engineering and Environmental Laboratory.
- In FY 2000, deployed the Multi-Agency Radiation Survey and Site Investigation Manual methodology and two new sensors (In-Situ Object Counting System and BetaScint) to characterize the Brookhaven National Laboratory graphite reactor facility and site.
- In FY 2000, completed deployment of twelve innovative technologies at Idaho and Fernald as a part of an integrated deactivation and decommissioning deployment project.

- In FY 2000, completed the development of a complex-wide protocol for the Reuse of Contaminated Concrete. The protocol will be implemented at Idaho National Engineering and Environmental Laboratory in FY 2001.
- In FY 2001, complete deployment of a highly-selective ion exchange system to remove targeted radionuclides (Cesium and Strontium) and non-radioactive contaminants from liquids at the Savannah River R Basin fuel storage pool. This technology will be evaluated against a second membrane technology developed, demonstrated and deployed by the Deactivation and Decommissioning Focus Area during the period of FY 1997 through FY 1999.
- In FY 2001, complete the Los Alamos National Laboratory Transuranic Waste Characterization and Disposition Large-Scale Demonstration and Deployment Project. Eight to ten innovative technologies will be demonstrated for characterization, decontamination, size reduction, and packaging of transuranic waste, including plutonium contaminated gloveboxes. Innovative decontamination and size reduction technologies showcased in this project will be compared to the baseline Decontamination and Volume Reduction System deployed at the Los Alamos National Laboratory in FY 2000.
- In FY 2001, complete the Mound Tritium Large-Scale Demonstration and Deployment project including the demonstration of ten to twelve innovative technologies for the decontamination, size reduction and removal of tritium-contaminated facilities and equipment. Technologies will also be demonstrated and deployed for the treatment of tritium-contaminated liquids and oils.
- In FY 2001, complete deployment of the Personal Ice Cooling System and Oxy-gasoline Torch. The Personal Ice Cooling System will be deployed at 12 DOE sites and Oxy-gasoline will be deployed 15 times at various DOE sites.
- In FY 2001, deploy the Standard Waste Box Counter at Rocky Flats to assay transuranic-contaminated equipment to the Waste Isolation Pilot Plant waste acceptance criteria standards.
- In FY 2001, deploy laser cutting system at Los Alamos National Laboratory to size reduce transuranic waste to fit into Waste Isolation Pilot Plant certified containers; technology may also be deployed at Rocky Flats Environmental Technology Site, the Nevada Test Site and at Hanford B-Cell in FY 2002 in conjunction with a remote work platform.

- In FY 2001 and FY 2002, deploy centralized and in-situ remote/robotic systems and tooling for characterization, decontamination, size reduction and removal of contaminated facilities, gloveboxes and equipment at Rocky Flats. These improved cost-effective technologies will reduce worker safety and health risk and accelerate deactivation and decommissioning schedules, thereby ensuring Rocky Flats Environmental Technology Site closure milestones are met.
- In FY 2002, demonstrate a minimum of five technologies for cost-effective material disposition at DOE sites such as Fernald, Idaho National Engineering and Environmental Laboratory and Oak Ridge.
- In FY 2002, initiate multi-site deployment projects of improved and innovative technologies demonstrated previously in the Mound Tritium Large-Scale Demonstration and Deployment Project, to address site needs related to characterization of tritium facilities and equipment and treatment of contaminated liquids and oils.
- Initiate in FY 2001, and increase emphasis in FY 2002, on the Mound Facilities Long-Term Stewardship Initiative. Technologies will be deployed for real-time, autonomous surveillance and monitoring systems that will provide DOE, regulators, and other public stakeholders the assurance that the public and the environment are protected from harm after final decontamination, decommissioning and site cleanup is completed.
- In FY 2002, demonstrate and deploy a telerobotic manipulation system for canyon process cells at Hanford. This system has applications to equipment and size reduction operations at the Hanford and Savannah River canyon facilities.
- In FY 2002, continue research, development and integration of remote/robotic systems that will accommodate multi-tasking deactivation and decommissioning activities. Basic and applied research will be conducted through the University Research Robotic Program and in support of robotics and intelligent machines activities that will reduce or eliminate worker health and safety risk and increase worker production.
- The FY 2001 Energy and Water Development report language included an earmark of $2,000,000 to the National Energy Technology Laboratory to be used for the continuation of the Mid-Atlantic Recycling Center for End-of-Live Electronics initiative in cooperation with the Polymer Alliance Zone. The Science and Technology program has allocated $27,105,000 to the Deactivation and Decommissioning Focus Area in FY 2001, which includes $2,000,000 for the Mid-Atlantic Recycling Center for End-of-Live Electronics initiative. No funding is included in the FY 2002 Science and Technology budget for this activity.

Funding Schedule

	FY 2000	FY 2001	FY 2002
Reactor Facilities	6,700	4,084	1,844
Radionuclide Separation Facilities	8,495	12,933	7,713
Fuel and Weapons Component Fabrication Facilities	11,127	10,088	7,998
Total, Deactivation and Decommissioning Focus Area	26,322	27,105	17,555

Detailed Program Justification

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Reactor Facilities **6,700** **4,084** **1,844**

There are 14 surplus production reactors across the DOE weapons complex which represent a significant portion of the Department's long-term deactivation and decommissioning mortgage. There are also over 100 test and research reactors throughout DOE and the United States (universities) that will require deactivation and decommissioning. More than half have already been placed in shutdown mode. Improved, innovative technologies are required to facilitate deactivation and decommissioning of these reactors to a degree such that they can be placed in interim safe storage for a long period of time (up to 50 years) with minimal surveillance and maintenance requirements. Highly contaminated fuel storage pools and facilities associated with the reactor also require improved technologies for characterization, decontamination and dismantlement.

Further, over 100 commercial nuclear power reactors exist in the U.S. and many are approaching their life expectancy. For this reason, the commercial nuclear utility industry will be a key participant in this effort and the technologies demonstrated should directly assist them in meeting their deactivation and decommissioning challenges, which are similar to those faced by DOE. Without these technologies, DOE sites and private industry will have no alternative but to adhere to their original technical baselines which will incur high cost, unacceptable worker risk, and long project duration to complete deactivation and decommissioning of these facilities.

In FY 2002, there is one distinct work element which supports this Product Line: Decontamination and Decommissioning Reactors and Fuel Storage Pools. Planned activities include:

- Initiate two industry projects. The first addresses the near-term need to adapt existing deactivation and decommissioning tools for deployment by robotic manipulator arms in order to improve deactivation and decommissioning efficiency and reduce worker risk. The second industry initiative is for advanced development research leading to improved systems designed to reduce the long-term surveillance and maintenance costs associated with DOE's production reactor facilities at Savannah River and Hanford.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

- Develop improved systems that will provide improved characterization, monitoring and sensing of radionuclides and hazardous materials to below release levels and for underwater applications.

Radionuclide Separation Facilities 8,495 12,933 7,713

Separation process facilities are typically highly contaminated, aging structures and represent the second largest portion of EM's surplus facility inventory. Improved, innovative technologies are required to deactivate and decommission radionuclide separation facilities, including gaseous diffusion plants, fuel reprocessing canyons and a wide variety of specific types of facilities (such as chemical separation, uranium recycling, lithium enrichment, heavy water production and tritium production).

Because of the large volumes of structural materials (e.g., metal and concrete), process equipment and piping found in these facilities, significant opportunities exist for improved methods leading to the cost-effective on-site disposition and/or reuse of these materials. Technologies are needed to characterize and monitor the full extent and nature of contamination; deactivate non-essential systems and utilities; decontaminate and dismantle large complex structures; and improve waste disposition. The main objective within this Product Line are to reduce the risks and costs associated with the deactivation and decommissioning of these nuclear facilities; lower waste disposal costs to DOE by demonstrating cost-effective solutions for material disposition; and to lower long-term surveillance and maintenance costs.

In FY 2002, there are two distinct work elements which support this Product Line: 1.) Contaminated Materials Disposition; and 2.) Deactivation and Decommissioning of Processing Facilities. Planned activities include:

- Demonstrate technologies for the safe and cost-effective disposition of stockpiled legacy waste and the minimization of newly generated deactivation and decommissioning waste. Improved technologies will be demonstrated for characterization, decontamination, size reduction, segregation and material handling to support cost-effective disposition and reuse options of newly generated and stockpile legacy materials.
- Conduct basic and applied research through the University Research Robotics Program and in support of robotics and intelligent machines activities for advanced remote/robotic systems in the areas of: sensor-based manipulation; mobility and navigation; task space analysis and visualization; and characterization, simulation and 3-D modeling.
- Demonstrate and deploy a telerobotic system for canyon process cells and riser pits at Hanford.
- Develop and demonstrate, through universities, improved systems to address long-term surveillance and monitoring needs associated with DOE's processing facilities.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Fuel and Weapons Component Fabrication Facilities 11,127 10,088 7,998

Fuel and weapon component fabrication facilities are found throughout the DOE complex and represent the largest group of surplus facilities. These facilities include weapon component fabrication, assembly, dismantlement, modification, and maintenance facilities. Former plutonium manufacturing facilities at Rocky Flats, Los Alamos National Laboratory, and Hanford are currently undergoing deactivation and decommissioning and have large volumes of transuranic contaminated materials and equipment. Rocky Flats has nearly 900 contaminated gloveboxes remaining and miles of contaminated process piping and ventilation ducts. Deployment of improved systems to reduce the size of plutonium gloveboxes, and the repackaging and characterization of the resulting transuranic waste will enable Rocky Flats to close more efficiently, at a lower cost, with decreased risk to workers. At the Los Alamos National Laboratory, there are over 300 plutonium gloveboxes with an additional 3,000 m^3 of transuranic waste expected to be generated beginning in FY 2000.

DOE's Mound and Savannah River Sites have many structures that contain tritium contamination. Improved and innovative technologies are required to address building and equipment characterization, decontamination and dismantlement, and metal and concrete waste disposal. Without improved and innovative technologies, DOE's fuel and weapon component fabrication sites will be forced to adhere to original technical baselines. These baseline approaches will increase the risk to workers and increase the cost and time needed for deactivation and decommissioning of these facilities.

In FY 2002, there is one distinct work element which supports this Product Line: Deactivation and Decommissioning of Weapons Fabrication Facilities. Planned activities include:

- Continue support of the Rocky Flats Deactivation and Decommissioning Initiative, focusing on deployment of innovative remote/robotic systems for the safe and cost-effective decontamination, size reduction and removal of plutonium and transuranic contaminated gloveboxes and other process equipment. In FY 2002 improved techniques will be developed and deployed for in-situ transuranic detection and for characterization of equipment embedded in concrete.
- Conduct basic and applied research and advanced integration of remote/robotic systems in the areas of: tetherless remote systems and communications, operator interface, and manipulator actuation and control through the University Research Robotics Program and in support of robotics and intelligent machines activities.
- Increase emphasis on the selection and deployment of an integrated real-time, autonomous system for the monitoring and surveillance of facilities and surrounding soils at the Mound site. This initiative, conducted in cooperation with the Subsurface Contaminants Focus Area, will serve as a prototype for long-term stewardship of DOE facilities and equipment and will seek to assure DOE, regulators and other stakeholders that the public and the environment are protected from harm after cleanup is complete.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Multi-site deployment of improved technologies previously demonstrated in the Mound Tritium Large-Scale Demonstration and Deployment Project. Technologies will be deployed which address characterization of tritium contaminated facilities and equipment and for the treatment of tritium contaminated liquids and oils.

Total, Deactivation and Decommissioning Focus Area	26,322	27,105	17,555

Explanation of Funding Changes from FY 2001 to FY 2002

	FY 2002 vs. FY 2001 ($000)
Reactor Facilities	
# Decrease due to the need to address higher priority requirements identified by the EM sites. Some technology development activities related to characterization and dismantlement of reactors and fuel pool structures and the removal of fuel pool sludges, debris and water will not be initiated in FY 2002	-2,240
Radionuclide Separation Facilities	
# Decrease due to the need to address higher priority requirements identified by EM sites. Some technology development activities related to decontamination technologies and systems which were planned to be conducted through private industry and universities will not be initiated in FY 2002	-5,220
Fuel and Weapons Component Fabrication Facilities	
# Decrease due to the need to address higher priority requirements identified by the EM sites. Some technology development activities related to deactivation technologies and systems which were planned to be conducted through private industry will not be initiated in FY 2002	-2,090
Total Funding Change, Deactivation and Decommissioning Focus Area	-9,550

Nuclear Materials Focus Area

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Nuclear Materials Focus Area is to develop technologies that support safe management and expeditious stabilization of nuclear materials currently under the purview of EM. The Nuclear Materials Focus Area will identify and implement technical solutions to the broad range of challenges associated with management of nuclear materials.

Program Goal

At the end of the Cold War, more than 800 million kilograms of nuclear materials remained at 44 DOE sites located in 19 states. The Nuclear Materials Focus Area supports the Nuclear Materials Stewardship Program in facilitating the integrated management of DOE's excess nuclear materials. The Nuclear Materials Focus Area will address technologies to meet nuclear material needs and requirements within the purview of EM. Nuclear materials includes those materials held under the purview of other DOE programs, but stored in EM facilities or sites. The specific materials scope of the Nuclear Materials Focus Area encompasses: transuranic isotopes; uranium/thorium; isotope materials and sealed sources; and all material contained in the Defense Nuclear Facilities Safety Board recommendations 94-1, 97-1, and 2000-1.

Management of these materials presents significant challenges due to the amounts and forms of materials, associated health risks, accelerated cleanup commitments, and non-proliferation concerns. In addition, the lack of knowledge and expertise in dealing with many aspects of nuclear material management has resulted in considerable technology gaps. The Nuclear Materials Focus Area will build on the existing systems and efforts to identify technology gaps or needs, to ensure that a plan for developing and deploying technology solutions is established, and foremost, that end-user needs are met on a timely basis. The Nuclear Materials Focus Area will work to assure that DOE meets its milestones to stabilize and disposition nuclear materials that pose risks as addressed in Defense Nuclear Facilities Safety Board Recommendations 94-1, 97-1, and 2000-1.

Program Objectives

The objective of the Nuclear Materials Focus Area is to provide technical solutions to:

- address urgent safety concerns for EM’s nuclear materials;
- develop and deploy new technologies for nuclear materials stabilization and disposition;

- enable progress towards meeting EM sites' baseline planning objectives;
- develop integrated solutions by building on existing systems and efforts and identifying any technology gaps in the steps to stabilize, store, and finally dispose of nuclear materials;
- provide support to meet DOE milestones to satisfy Defense Nuclear Facilities Safety Board Recommendations 94-1, 97-1, and 2000-1 as originally scheduled or as revised; and
- coordinate plans and resolutions between the Nuclear Materials Focus Area and other Focus Areas; the EM Science Program, Site Technology Coordination Groups; and other EM Program Offices.

Significant Accomplishments and Program Shifts

The Nuclear Materials Focus Area provides for the continuity of the existing programs and builds on existing technical capabilities. The program is end-user oriented in terms of focusing its activities on technology user needs. This emphasis on technology user needs will facilitate accelerated deployment of new and cost effective technologies to accomplish the EM sites' baseline planning goals and milestones.

- In FY 2000, demonstrated performance of porous crystalline matrix materials to absorb and stabilize significant quantities of problematic actinide solutions.
- In FY 2001, develop process flow adjustments for Rocky Flats materials stabilization at the Savannah River Site.
- In FY 2001, deploy furnace load-out system for stabilized plutonium materials at the Hanford site. This furnace system will reduce the furnace cycle time from 16 to 3 hours, allowing for increased production.
- In FY 2001, deploy super critical fluid extraction moisture measurement technology at the Rocky Flats and Hanford sites to achieve a reliable moisture measurement of plutonium materials for shipment and to avoid erroneous measurements which result in slow and costly repackaging of materials, ultimately compromising site schedules.
- In FY 2001, deploy a vacuum transfer system at Fernald for repackaging enriched uranium to reduce human exposure and reduce health and safety risks.
- In FY 2002, deploy Russian based technologies to treat problematic solutions at the Idaho National Engineering and Environmental Laboratory and Hanford site.
- In FY 2002, deploy supercritical fluid extraction moisture measurement technology at the Savannah River site.
- In FY 2002, demonstrate the High Integrity Can for storage and transportation of disrupted spent nuclear fuel to enable spent nuclear fuel to be moved between facilities and into dry storage at the Idaho National Engineering and Environmental Laboratory.

- # In FY 2002, deploy Molten Salt Oxidation at Los Alamos National Laboratory for treatment of combustible plutonium materials.
- # In FY 2002, initiate two new Product Lines to address technology gaps related to: problematic nuclear materials where stabilization is not sufficient for transport or storage; and stabilization, characterization and packaging of spent nuclear fuel.
- # In FY 2002, continue emphasis on basic science and applied research to address mid to long-term stabilization and disposition of nuclear materials.

Funding Schedule

	FY 2000	FY 2001	FY 2002
Stabilization	2,975	4,899	4,900
Packaging Transportation and Storage	1,026	3,055	0
Material Processing	0	0	1,083
Spent Nuclear Fuel	0	0	3,664
Total, Nuclear Materials Focus Area	4,001	7,954	9,647

Detailed Program Justification

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Stabilization **2,975** **4,899** **4,900**

Many nuclear materials remain in unstabilized forms at many DOE sites. Prior to site closure these materials were prepared for short-term storage, which was adequate for the expected storage time. With site closure, many of these materials, along with impurities, are not in a condition suitable for shipment to a long-term storage facility without being stabilized. In many cases, stabilization progress is a key element of site closure because stabilization is required before the material can be shipped to a receiver site. For plutonium materials, the lack of adequate moisture measurement techniques presents a major obstacle in satisfying long-term storage standards. Stabilization of nuclear materials remains a high priority activity within EM to satisfy both Defense Nuclear Facilities Safety Board and stakeholder agreements.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Stabilization technology development activities will include direct measurement techniques that have been developed for relatively pure materials to residues and the development of noninvasive techniques to measure moisture and other impurities will be investigated. Research will be performed to develop technologies to process plutonium contaminated materials within current operational constraints and allow appropriate waste disposal. In some cases, the material is classified in its current form, limiting disposition options. Without this work, the stabilization process for the Savannah River Site F-Canyon and H-Canyon environments would not be developed and, consequently, Savannah River will not be able to process materials to meet storage and waste criteria for the Waste Isolation Pilot Plant or repository. In addition, failure to perform this work will lead to potential DOE facility and site closure delays, reduced facility safety, missed Defense Nuclear Facilities Safety Board milestones, failure to satisfy compliance agreements, and increased safeguards and security costs.

In FY 2002, one distinct work element supports this Product Line: Nuclear Material Stabilization. Planned activities include:

- Deploy supercritical fluid extraction moisture measurement technology at the Savannah River Site.
- Deploy Russian based technologies to treat problematic solutions at the Hanford Site and the Idaho National Engineering and Environmental Laboratory.
- Initiate work to determine the role that improved nondestructive assay techniques could serve in improving nuclear material stabilization activities.
- Investigate neutron moderation technology as a bulk moisture measurement technique for stabilized plutonium materials.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Packaging, Transportation and Storage 1,026 3,055 0

All DOE closure sites that processed nuclear materials have materials that need to be packaged in an acceptable container and transported. Currently, there is no capability to adequately characterize the residual materials for shipment resulting in expensive analyses and testing for each container of material that needs to be transported. Consequently, the ability to develop packaging and transportation capabilities for nuclear materials is a critical element in meeting EM sites' sites closure schedules and commitments.

Packaging, transportation and storage technology development activities will address this issue through two related efforts. One effort includes both an experimental thrust to measure gas generation rates for selected materials and the longer term development of a modeling capability to predict gas generation rates for other materials. The other effort addresses the worker radiation exposure issue associated with the packaging of nuclear materials. Limited numbers of trained radiation workers remaining in the complex, combined with the need to maintain low individual exposure levels, has already limited packaging operations at some sites. Techniques will be developed to automate packaging processing and increase packaging rates. Failure to address these issues will result in increased worker radiation exposure, failure to satisfy stakeholder agreements, increased safeguards and security costs, delays in facility closure, and delays in site closure. Failure to remove these materials from key facilities will make it impossible for EM to satisfy stakeholder agreements and achieve mortgage reduction goals. Some of these nuclear materials exist in chemical and physical forms that were not historically transported in the complex. Their transportation is now necessary due to a lack of processing capabilities at many sites. Unsettled issues regarding potential gas generation drastically limit the transportation of nuclear materials within the complex.

No activity.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Material Processing 0 0 1,083

Most nuclear materials, once stabilized, are ready for both transport and disposition, whether that is long-term storage or waste. However, a significant quantity of materials cannot be stored safely or cost-effectively without further processing. Consequently, material processing technology development activities will enable developing better technologies where ineffective or cost prohibitive technologies are currently in place, or developing innovative technologies to replace ones that can no longer be used due to stakeholder commitments and other inter-agency agreements. Material processing is needed to meet the standards established for 50-year storage of plutonium, and criteria for long term storage that reduces the worker radiation exposure. Research and development is needed for processes that meet current operational constraints and reduce the large waste volumes and lengthen equipment life expectancy. Technology development and deployment will address a variety of nuclear materials that range from small to large quantities and have unique chemical and physical forms. The materials range from low-content residues to unusual fuel types to neutron sources. Research efforts span a variety of technologies including improving precipitation processes, overcoming dissolver off-gas restrictions, residue-processing techniques, and decontamination techniques.

Technologies will be developed for separating metals, salts, and oxide residue; decontaminating uranium metals and volumes; and converting classified shapes. A secondary focus will be to develop technologies for improving both precipitation rates for processing materials at the Plutonium Finishing Plant and processing Rocky Flats Environmental Technology Site plutonium materials. Failure to adequately address these materials will result in increased failure to satisfy stakeholder agreements, increased safeguards and security costs, worker radiation exposure, and potential delays in facility and site closures.

In FY 2002, one distinct work element supports this Product Line: Standard and Non-Standard Process Development. Planned activities include:

- Define new or modified flow sheets for processes at Hanford, Savannah River, Los Alamos National Laboratory, and other sites.
- Demonstrate technique for the processing of Rocky Flats Environmental Technology Site materials at the Savannah River Site.
- Deploy Molten Salt Oxidation at Los Alamos National Laboratory for treatment of combustible plutonium materials.
- Conduct experimental work with depleted uranium for the dry blending process.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Spent Nuclear Fuel 0 0 3,664

Currently, there is a large quantity of spent fuel under the purview of EM. EM spent nuclear fuels are, for the most part, to be packaged dry into sealed, metal (typically stainless steel) canisters and stored in dry facilities for periods up to 30 years or more before transfer to a federal repository. Also included in this product line are the cesium-strontium capsules stored at Waste Encapsulation and Storage Facility. Development of the monitoring techniques for the canisters is important to assure the absence of integrity threatening corrosion or excessive internal pressurization. Another major issue in placing the fuels in canisters is demonstrating that the canisters will be acceptable for repository disposal in 30 years. Some issues are the presence of water reacting on the spent nuclear fuel surfaces with the spent nuclear fuel materials, the presence of epoxies in the fuel support structures, and the presence of other chemical from the supporting structures creating unacceptable compounds in the spent nuclear fuel storage environment or causing unacceptable damage to the spent nuclear fuel surface. There is a need to characterize and study fuel specific degradation mechanisms spent nuclear fuels previously stored in water basins in interim dry storage and in repository storage. The spent nuclear fuel materials addressed in this package are located primarily at the Idaho National Engineering and Environmental Laboratory, Hanford, and Savannah River sites. Validation and demonstration of the technologies would be performed at these facilities to eliminate the shipping of materials. However central coordination would be required to coordinate development and enable disposition of the spent nuclear fuels.

Planned technology development activities will include performing studies to ensure that the fission characteristics of Neptunium-237 are adequately known. Technologies to cost-effectively encapsulate or process spent fuel, including automation of processes, so that it is acceptable for disposition at the federal repository in 30 years will also be developed. Technologies will also be developed that address the issues associated with the water, epoxies, and other materials included with spent fuel. A basis for standardizing the canister to achieve lowered facility costs and minimize worker radiation exposure will be developed as well. Failure to adequately address these materials will result in increased failure to satisfy stakeholder agreements, increased safeguards and security costs, delays in facility closure, and delays in site closure.

In FY 2002, one distinct work element supports this Product Line: Spent Nuclear Fuel.

- Develop experimental plan and prepare sources for testing in Non-Destructive Assessment.
- Perform studies to determine the fission characteristics of spent nuclear fuels.
- Determine if the Non-Destructive Assay technology is capable of measuring a specific radionuclide as a part of an overall assay.
- Complete development of methodology to resolve how much residual water and epoxy is acceptable in spent nuclear fuels cans. Define system requirements for debris removal from sludge and water.
- Initiate automation studies for the handling, processing, and packaging of fuels to achieve lowered cost and worker exposure.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

- # Develop design requirements from testing of prototype standard containers.
- # Demonstrate the High Integrity Can for storage and transportation of disrupted spent nuclear fuel at the Idaho National Engineering and Environmental Laboratory.

Total, Nuclear Materials Focus Area	4,001	7,954	9,647

Explanation of Funding Changes from FY 2001 to FY 2002

	FY 2002 vs. FY 2001 ($000)
Stabilization	
# No significant change	1
Packaging, Transportation, and Storage	
# Decrease is due to the initiation of higher priority material processing and spent nuclear fuel technology development	-3,055
Material Processing	
# Increase reflects initiation of activities to address the needs of problematic nuclear materials where stabilization is not sufficient for transport or storage	1,083
Spent Nuclear Fuel	
# Increase reflects initiation of activities to address technology needs related to stabilization, characterization and packaging of spent nuclear fuel	3,664
Total Funding Changes, Nuclear Materials Focus Area	1,693

Environmental Management Science Program

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Environmental Management Science Program is to develop and fund a targeted long-term basic research program that will result in transformational or breakthrough approaches for solving the Department's environmental problems. This program is a collaborative effort between the Department's Office of Environmental Management and Office of Science.

Program Goal

The goal of the Environmental Management Science Program is to ensure that sound science governs environmental management decisions. The program will solicit and support world-class basic research that has the potential to lead to significant, quantum improvements in the understanding of scientific principles and phenomena in areas of interest to the EM mission; to validate existing technical solutions to complex problems; to provide technical solutions where currently there are none; and to lead to future risk reduction and cost and time savings.

Program Objectives

The Office of Environmental Management and DOE's Office of Science through the Environmental Management Program are collaborating to fund longer-term basic research to solve intractable problems that threaten the successful closure of DOE sites.

The Office of Environmental Management is the lead organization for the planning and budgeting of the program. The Office of Science is responsible for ensuring that the research projects have scientific merit and facilitate research coordination with similar programs within DOE and other agencies. Idaho and the Office of Science and Technology's Focus Areas assist in identifying needs, involving stakeholders, managing financial aspects, and communicating research results to EM end-users.

The Environmental Management Science Program works with the Office of Science and Technology Focus Areas to provide assurance that basic scientific knowledge is advanced to support the development of cutting-edge environmental solutions and technologies. Delivery of innovative technologies to accomplish faster, lower risk, more complete, and cheaper cleanup is possible only if a scientific knowledge base exists to support new technology development activities.

The importance of basic scientific research to the EM cleanup mission has been established in several reports, specifically the Galvin Commission report (1995) entitled Alternative Futures for the Department of Energy National Laboratories and the National Research Council report (1996) entitled “Improving the Environment: An Evaluation of DOE's Environmental Management Program.”

Since its inception in 1996, the EM Science program has supported 316 research projects. The Environmental Management Science Program's portfolio addresses the most challenging technical problems of EM related to high-level waste; subsurface contamination including contamination in the vadose zone; deactivation and decommissioning; mixed waste; nuclear materials; and health, ecology, and risk. Each new solicitation supports EM's needs. Work is ongoing with the National Research Council of the National Academy of Sciences to facilitate the preparation of long-term research plans for the Department's most intractable problems. The research plan for subsurface contamination was completed in March 2000. Research plans are being prepared for high level waste and deactivation and decommissioning. These plans will be completed in Spring 2001. A research plan for mixed and transuranic waste was initiated in January 2001 and is expected to be completed by Spring 2002.

The 202 research projects initiated in FY 1996 and FY1997 are coming to completion. In FY 2000, competitive renewal research grants were awarded to 42 of the most promising research projects originally funded in FY 1996 and FY 1997. In FY 2001, 30 to 45 new awards will be initiated to address issues related to high level waste and deactivation and decommissioning. In FY2002, 10 to 15 new awards will be initiated to address issues related to subsurface contamination and long-term stewardship.

The research projects are successfully transferring research results to site problem holders and technology developers. As of the end of FY 2000, the researchers have published over 541 journal articles, 42 thesis or dissertations, and 35 other manuscripts or encyclopedia articles. The researchers have also applied for 28 patent disclosures and applications. The research results are being used rapidly as exemplified by 12 field tests, 12 commercializations, and two deployments. To date, over 550 graduate students have been supported by the projects sponsored by the EM Science Program. In April 2000, a complex wide workshop with over 550 participants was held to bring together researchers and site problem holders to facilitate communication of results and ongoing research by the researchers and of issues by site personnel.

Significant Accomplishments and Program Shifts

- Awarded 316 basic research projects at 90 universities, 13 national laboratories, and 32 other governmental and private laboratories in 39 states and 7 countries. This includes the 42 renewals for the most promising FY 1996 and FY 1997 basic research projects.
- Held a second complex-wide workshop in April 2000 to facilitate communication between researchers and EM site problem holders and technology developers and to present research results available to date.
- Identified new waste forms and disposal strategies for crystalline silicotitanate that is produced from cesium and strontium ion exchange processes. Research has shown that the durabilities of waste forms resulting

from a simple heat treatment of the cesium-loaded crystalline silicotitanate were much greater than that of borosilicate glass. This research is enabling the evaluation of technologies being considered at Savannah River for the treatment of high level wastes.

- Developed two state-of-the-art monitors for personal and environmental exposure for inhaled radionuclides. Together these instruments permit the air concentrations of the gas, the airborne particulates, and their particle size distribution to be measured on a continuous basis. The new instruments have been deployed at Fernald and potentially have a wide application at other DOE sites.
- Developed process for extracting cesium from high-level waste using a calixarene-crown.Cesium will require no treatment before vitrification. This research has contributed to one of the processes that is being evaluated at Savannah River to treat high-level waste.
- Evaluated antifoaming agents that can be used in the Defense Waste Processing Facility at Savannah River.
- Genetically modified several plant species to phytoremediate shallow soil contaminated with mercury.
- Developed a nonintrusive electromagnetic imaging system for the shallow subsurface. A prototype has been tested at the Idaho National Engineering and Environmental Laboratory.
- Provide new understanding of collodial agglomerates in tank sludge to improve retrieval of high- level waste and potentially reduce cost of retrieval.
- Provide new understanding of fluid flow and contaminant transport in a fractured vadose zone at Hanford and the Idaho National Engineering and Environmental Laboratory.

As the EM Science Program matures, it will continue to fund basic research and development to address the evolving science needs of EM sites. The program intends to ensure that it is addressing the right research questions, disseminating research results, and getting the "best science" by:

- Initiating, in FY 2001, 30 to 45 new research awards to address issues related to high level waste and deactivation and decommissioning.
- Initiating in FY 2002, 10 to 15 new research awards to address issues related to subsurface contamination and long term stewardship.
- Developing a national science research plans based on needs identified by sites through the project baseline summaries and in consultation with scientific experts. The National Academy of Sciences/National Research Council will complete plans for high-level waste and deactivation and decommissioning in Spring 2001. A research plan for subsurface contamination problems was completed in March 2000. In January 2001, the National Research Council initiated a long term research plan for transuranic and mixed waste with an expected completion date of Spring 2002.

The EM Science program supports DOE's strategic goal to deliver the scientific understanding and technological innovations that are critical to the success of DOE's mission and the nation's science base. The program directly supports the objective to develop the science that underlies DOE's long-term mission

Funding Schedule

	FY 2000	FY 2001	FY 2002
FY 1997 Awards	7,924	0	0
FY 1998 Awards	10,400	6,700	0
FY 1999 Awards	6,011	12,630	5,500
FY 2000 Awards	5,400	7,200	12,500
FY 2001 Awards	0	7,945	9,400
FY 2002 Awards	0	0	2,385
Integration of Research Results into the Program	1,500	1,519	1,500
Small Business Innovative Research Program	0	925	765
Total, Environmental Management Science Program	31,235	36,919	32,050

Technical Problem Areas	FY 2000 Appropriation	Number of Awards Initiated	Number of Awards in Portfolio	FY 2001 Appropriation	Number of Awards Initiated [a]	Number of Awards in Portfolio [b]	FY 2002 Request	Number of Awards Initiated	Number of Awards in Portfolio [b]
Deactivation and Decommissioning	5,174	1	23	8,256	20	39	6,015	0	34
High Level Waste	11,448	14	81	13,616	20	76	9,785	0	54
Mixed Waste	1,194	3	35	240	0	12	1,000	0	3
Spent Nuclear Fuel	1,447	3	8	143	0	8	1,200	0	3
Nuclear Materials	1,662	0	8	0	0	6	0	0	0
Subsurface Contamination	8,357	18	132	13,188	0	60	11,810	10	59
Health Ecology Risk	1,018	3	21	551	0	11	875	0	3
Low Dose Radiation	935	0	8	0 [c]	0	8	600	0	8
Small Business Innovative Research Assessment	0	0	0	925	0	0	765	0	0
Total, EM Science Program	31,235			36,919			32,050		
Total Number of Awards		42	316		40	220		10	164

NOTES:

Number of awards initiated is the number of new or continuation awards initiated in that fiscal year.

Number of awards in Portfolio is the number of awards being managed in that fiscal year. This includes awards initiated in prior years and are still being managed in the Portfolio.These awards may have received funding during the current fiscal year or may be using prior year funding (especially universities which are funded in either one 3-year increment or 2 18-month increments).

Awards are managed until the final reports are received and disseminated.

The FY 1996 awards were completed at the end of FY 2000 and their final reports are due by mid FY 2001.

The FY 1997 awards will be completed by the end of FY 2001 and their final reports are due by mid FY 2002.

---

[a] Estimate.

[b] Estimates for the number of awards in Portfolio is for the number of awards expected to be ongoing at the end of the Fiscal Year.

[c] DOE Office of Science funded mortgages for the awards in the Low Dose technical problem area in FY 2001.

Detailed Program Justification

(dollars in thousands)

FY 2000	FY 2001	FY 2002

FY 1997 Awards 7,924 0 0

In FY 1997, 66 additional three-year research projects were initiated. Over half of the 66 award recipients are collaborative efforts among universities, laboratories and private industry. Of these projects, 28 are led by universities; 31 by DOE national laboratories; and seven by private industry, nonprofit research centers, and other Federal laboratories. Twenty-two of the projects focus on finding better ways to treat and destroy high-level radioactive waste; nine focus on waste containing a mixture of radioactive and other hazardous materials; five focus on spent nuclear fuel treatment and destruction; and six address the materials used in weapons production (nuclear materials). The remaining 24 projects deal with the science needed to improve remedial action processes, to safely carry out deactivation and decommissioning of DOE sites, and to better understand the health and ecological risks associated with environmental cleanup options. The research funded at the national laboratories is focused on problems in the areas of: radioactive tank waste (43%), nuclear materials (18%), subsurface contaminants (14%), decontamination and decommissioning (8%), mixed waste characterization, treatment, and disposal (4%), spent nuclear fuel (4%), and research projects supporting multiple categories (9%).

In FY 2000, funding was completed for awards initiated in FY 1997. A final report will be submitted within 90 days of each award's completion. Final reports will be available in FY 2001.

FY 1998 Awards 10,400 6,700 0

In FY 1998, 33 additional three-year research projects were initiated involving 23 universities, 6 DOE national laboratories and seven private industry or other Federal laboratories, in 20 states. A total of two-thirds of the 33 award recipients are collaborative efforts among universities, laboratories and private industry. Of these projects, nine are led by universities; 22 by DOE national laboratories; and two by private and other Federal laboratories. Twenty of the projects focus on finding better ways to treat and destroy high level radioactive waste and 13 deal with the science needed to improve and safely carry out the deactivation and decommissioning of DOE sites. The research funded at the national laboratories is focused on problems in the area of radioactive tank waste (64%) and deactivation and decommissioning (36%).

In FY 2001, complete funding for awards initiated in FY 1998 in the areas of high-level waste and deactivation and decommissioning. A final report will be submitted within 90 days of each award's completion. Final reports will be available in FY 2002.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

FY 1999 Awards 6,011 12,630 5,500

In FY 1999 31 three-year research awards to 20 universities, 8 DOE National Laboratories and 3 other research institutions were initiated to address scientific problems associated with vadose zone, subsurface contamination, and groundwater issues to support initiatives at sites such as Hanford. In addition, 8 research awards at 4 universities and private research institutions and 2 DOE National Laboratories were initiated to develop a better scientific basis for understanding exposures and risks to humans from low dose radiation. Research was selected based on its scientific merits and its relevance to the EM mission.

Continue to support research awards in the area of vadose zone, subsurface contamination and groundwater and in the area of exposures and risks from low dose radiation.

FY 2000 Awards 5,400 7,200 12,500

In FY 2000, 42 renewal awards were initiated in September 2000 to address scientific issues associated with subsurface contamination (18 awards), high-level waste (14 awards), mixed waste (3 awards), spent nuclear fuel (3 awards), deactivation and decommissioning (1 award), and health/ecology/risk (3 awards) that are facing the Environmental Management program. These 42 awards are renewals of the most promising research projects initiated during FY 1996 and FY 1997 under the EM Science Program.

Support 42 renewal awards to address scientific issues associated with problems facing the Environmental Management Program.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

FY 2001 Awards 0 7,945 9,400

In FY 2001, 30 to 45 new awards will be made in September 2001 to address issues related to high level waste and deactivation and decommissioning. Awards will address needs primarily identified at Hanford, Savannah River, Idaho, and Oak Ridge, by Focus Areas, and in the National research Council's reports for long term research needs. In the high level waste area, research may focus on long-term issues related to tank closures; to high-efficiency, high-throughput separation methods that would reduce high-level waste program costs including high-efficiency separation and minimization of the volume of secondary waste; robust, high loading, immobilization methods and materials that could provide enhancements or alternatives to current immobilization strategies including alternatives to borosilicate glasses using slurry-fed electric melter as immobilization matrix and alternative melter techniques; and innovative methods to achieve real-time, and when practical in situ characterization data for high level waste and process streams that would be useful for all phases of the waste management program with emphasis on characterization of the waste after retrieval, for instance in process streams and melter feeds. In the deactivation and decommissioning area, research may focus on characterization including the identification of means, preferably real-time, minimally invasive, and field usable, to locate and quantify difficult to measure contaminants; development of biotechnological sensors to detect contaminants of interest and to provide a new way to meet characterization needs; to provide fundamental understanding of the interactions of important contaminants wit the primary materials of interest in decontamination projects, including concrete, stainless steel, paints, and "strippable" coatings; to provide biotechnological means to remove or remediate contaminants of interest from surfaces and within porous materials; and to develop intelligent remote systems that can adapt to a variety of tasks and be readily assembled from standardized modules including research on actuators, universal operational software to provide criteria-based decision making, and virtual reality systems to allow workers to perform essential survey and decision making functions from a remote location thus enhancing worker safety and productivity.

Issue 30 to 45 new awards to address issues related to high level waste and deactivation and decommissioning.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

FY 2002 Awards 0 0 2,385

In FY 2002, 10 to 15 new awards will be made by September 2002 to address issues related to subsurface contamination and long term stewardship. Awards will address needs primarily identified at Hanford, Savannah River, Idaho, and Oak Ridge, by Focus Areas, and in the National Research Council's reports for long term research needs. To address subsurface contamination issues, research may focus on: location and characterization of subsurface contaminants and characterization of the subsurface which includes contaminant fate and transport behavior, techniques to measure or estimate heterogeneity of the contaminants, improve capabilities to measure migration of the contaminants; conceptual modeling which includes improving the understanding of contaminant fate and transport and the interaction of these processes with physical, chemical, and biological processes, and model parameter development; containment and stabilization which includes development of robust physical, chemical, and biological containment and stabilization systems and development of new containment systems; monitoring and validation which includes development of methods for designing monitoring systems to detect both the current conditions and changes in system behavior and development of validation processes; etc. Research needed to support long term stewardship will focus on issues identified in the long term stewardship roadmap that is currently under development

- # Issue 10 to 15 new awards to address issues related to subsurface contamination and long term stewardship.

Integration of Research Results into the Program 1,500 1,519 1,500

Success of the EM Science Program is dependent on the application of scientific results in EM Focus Areas and directly in field activities, enhancing EM's ability to meet compliance requirements.

- # Disseminate research results from completed or ongoing projects to EM project managers based on science needs and problem areas and to potential technology developers. Provide links with DOE project managers, research community, and potential technology users.
- # Conduct topical workshops and seminars on specific science topics and/or site specific topics to disseminate results in a timely manner. Conduct a third complex-wide workshop to disseminate basic research results to technology developers and to site managers.
- # Implement process with the Focus Areas to review the results of completed awards to determine if the next step is additional follow-on basic research, applied research, incorporation of results directly into technology development, or direct application of results to an EM problem area.
- # Refine and improve long-term site specific and national science research plans based on needs identified in EM's cleanup strategy and through EM's roadmapping effort. Complete research plans for high-level waste and deactivation and decommissioning in FY 2001 and in FY 2002 complete an additional research plan for mixed and transuranic waste.

(dollars in thousands)

	FY 2000	FY 2001	FY 2002
Small Business Innovative Research Program	**0 [a]**	**925**	**765**
# Assessment on research funds in accordance with Public Law 102-564.			
Total, Environmental Management Science Program	31,235	36,919	32,050

Explanation of Funding Changes From FY 2001 to FY 2002

	FY 2002 vs. FY 2001 ($000)
FY 1998 Awards	
# Decrease reflects completion of funding, in FY 2001, of the research projects initiated in FY 1998	-6,700
FY 1999 Awards	
# Decrease reflects reduced mortgages related to research projects initiated in FY 1999	-7,130
FY 2000 Awards	
# Increase supports higher mortgages related to research projects initiated in FY 2000	5,300
FY 2001 Awards	
# Increase supports higher mortgages related to research projects initiated in FY 2001	1,455
FY 2002 Awards	
# Increase supports new research projects to be initiated in FY 2002	2,385
Integration of Research Results into Program	
# No significant change	-19
Small Business Innovative Research Program	
# Decrease due to smaller small business innovative research assessment in FY 2002	-160

[a] $765,000 transferred to the DOE Office of Science for award and administration of grants to small business.

	FY 2002 vs. FY 2001 ($000)
Total Funding Change, Environmental Management Science Program	-4,869

Idaho Environmental Systems Research and Analysis

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Environmental Systems Research and Analysis program (formerly known in FY 2001 as the Validation and Verification Program) is to provide a directed research program focused on both core and problem driven research leading to fully developed and deployable scientific and technological solutions to address EM's cleanup and long-term stewardship problems. The research program targets science and technology needs and gaps identified by the scientific community in partnership with the EM sites and supports development, deployment and application of innovative technologies across the EM complex.

Program Goal

The goal of the Environmental Systems Research and Analysis program is to conduct both core and problem-driven research that supports the EM mission through utilization of the capabilities of the Idaho National Engineering and Environmental Laboratory as the EM Lead Laboratory. This research compliments the basic research program funded by the EM Science Program and the applied research funding by the Focus Areas.

Program Objectives

The primary objective is to support problem-driven research that is based on the technology needs and gaps that have been defined by the scientific community in partnership with the sites. The core research will identify and develop the tools and capabilities needed to address the interim and outyear needs of EM.

Significant Accomplishments and Program Shifts

- In FY 2000, designed and fabricated an ion trap, secondary ion mass spectrometer (IT-SIMS) for the purpose of measuring the chemical speciation of radionuclides and toxic metals on the surfaces of environmentally significant minerals. Understanding the speciation of these contaminants leads to better prediction of their fate and transport in the environment.
- In FY 2000, demonstrated a computational method for the solution of the smoothed particle hydrodynamic model for the simulation of low speed flows. This model will enhance capability to predict the movement of contaminants in the subsurface.

- In FY 2000, completed a draft of the National Vadose Zone Roadmap. In FY 2001, a revised National Vadose Zone Roadmap will be completed and will be independently peer reviewed. A final peer reviewed version is expected to be completed in FY 2002. This roadmap will enable better planning for future science and technology development investments related to vadose zone issues and needs.
- In FY 2000, deployed improved non-destructive assay hardware and software for enhancing the quality and efficiency of transuranic waste characterization for shipment. These improvements provide faster and more accurate characterization of containerized transuranic waste for shipment to the Waste Isolation Pilot Plant, leading to lower costs.
- In FY 2000, determined the hydrologic gradients in variably saturated vadose zones at numerous sites in the complex by utilizing the Advanced Tensiometer. These gradients determine the directions and speed in which contaminants might move.
- In FY 2000, completed Idaho National Engineering and Environmental Laboratory disposition maps that identify site waste streams, volumes, and disposal facilities. The disposition maps provide the opportunity for integrating operations for environmental restoration, waste management and disposition, leading to lower overall costs.
- In FY 2000, completed deactivation and decommissioning life-cycle maps for Idaho National Engineering and Environmental Laboratory, Savannah River Site and Hanford's 300 Area. This analysis allowed EM to gain a greater understanding of the deactivation and decommissioning mortgage and waste volumes expected from deactivation and decommissioning activities.
- In FY 2001, continue integration and systems engineering activities to further refine EM waste, spent nuclear fuel, and nuclear materials disposition baselines and to identify and implement new opportunities to accomplish more efficient and cost effective cleanup/closure of DOE sites.
- In FY 2001, initiate new research projects and continuations targeted to address issues related to subsurface contamination, waste management (including spent nuclear fuel). The projects selected will be targeted to the needs identified by EM sites.
- In FY 2001, deploy the ion trap, secondary ion mass instrument and begin making measurements on radioactive samples. Understanding the speciation of the radionuclides on soil samples will provide data for predicting the movement of radionuclides in the subsurface.
- In FY 2001, deploy two new probe-hole characterization instruments. These new instruments will have the capability of detecting and mapping subsurface distributions of radionuclides and Resource Conservation and Recovery Act metals. These distributions will be important in designing remediation or long-term stewardship strategies.

Funding Schedule

	FY 2000	FY 2001	FY 2002
Environmental Systems Research Analysis	33,273	21,000	0
Total, Environmental Systems Research and Analysis	33,273	21,000	0

Detailed Program Justification

(dollars in thousands)

	FY 2000	FY 2001	FY 2002
Environmental Systems Research and Analysis	**33,273**	**21,000**	**0**

The Environmental Systems Research and Analysis program conducts research in the areas of deactivation and decommissioning, characterization and treatment of transuranic and mixed waste, stabilization of spent nuclear fuel, and long-term stewardship --- with a special emphasis on subsurface and related sciences. Environmental Systems Research and Analysis research augments EM's ability to transition basic science to engineering application and problem solution and enhances the ability of the Science and Technology program to provide technical assistance to the end-users.

In FY 2001, new projects will be initiated and ongoing projects will be supported. The research portfolio will include Subsurface and Waste Management (including spent nuclear fuel) science projects.

No activity.

Total, Environmental Systems Research and Analysis Program	33,273	21,000	0

Explanation of Funding Changes from FY 2001 to FY 2002

	FY 2002 vs. FY 2001 ($000)
Environmental Systems Research and Analysis	
# Due to the need to address higher priority requirements as identified by the EM sites, no funding is requested for Environmental Systems Research and Analysis program in the FY 2002 Congressional Budget request.	-21,000
Total Funding Changes, Nuclear Materials Focus Area	-21,000

Technology Applications

Mission Supporting Goals, and Objectives

Program Mission

The mission of the Technology Applications program is to aggressively foster partnerships and create opportunities to accelerate the application of new technologies, processes, and knowledge to solve Environmental Management problems. This is accomplished through the development of initiatives, policies, and procedures that unite end-users, regulators, stakeholders, and technology vendors together with technology developers to enable and ensure widespread use of new technologies throughout EM. The Office of Technology Applications is also responsible for coordinating and integrating Office of Science and Technology activities within the EM corporate structure; reporting Office of Science and Technology performance and accomplishments; and maintaining EM Laboratory Management oversight.

Program Goal

The goal of the Technology Applications program is to provide the Office of Science and Technology with effective tools to:

- Accelerate the deployment of new technologies and the application of knowledge to accelerate the schedule, decrease the cost, or decrease the risk of the DOE clean-up; and,
- Provide credible independent program and technology assessments/peer review, business analyses, and performance data in order to improve the effectiveness of the program;
- Communicate program successes and accomplishments internal and external to the department;
- Support the integration of worker health and safety activities into the technology development process.
- Facilitate leveraging of foreign cleanup technologies and expertise.

Program Objectives

The Technology Applications program objectives are to continue the trend of increased beneficial technology use in EM through the development and implementation of incentives to the site contractor and close coordination with the State-led Interstate Technology and Regulatory Cooperation Working Group on multi-site technology deployment. Increase efforts to incorporate industry worker health and safety standards

into technology development activities through partnerships with industry representatives and universities during technology development and demonstration activities.

Strengthen coordination with other Federal Agencies and with international organizations to facilitate exchange of environmental technology information and participation in joint activities. Improve the Office of Science and Technology communication and technical assistance role throughout EM to support first time deployments of both industry- and DOE-sponsored technologies. Provide information to aid EM in making technology decisions on, not only DOE developed technologies, but related work being done by universities and other agencies.

Significant Accomplishments and Program Shifts

- In FY 2001, support State-led technology integration projects associated with the implementation of alternative landfill covers, technical aspects of institutional controls, and assessment of monitoring/remote data collection for long-term stewardship activities.
- In FY 2001, complete complex wide analysis of contractor agreements with respect to incentives/disincentives for deployment of new and innovative technologies.
- In FY 2001, complete EM Laboratory Management Policy review and framework for institutional plan.
- In FY 2001, assist the State-led Interstate Technology and Regulatory Cooperation Working Group to hold site based workshops to facilitate deployment and acceptance of key new technologies at the Hanford, Savannah River, and Ohio Sites.
- In FY 2001, conduct and publish 11 worker health and safety assessments in conjunction with the Office of Science and Technology sponsored technology demonstrations.
- Continue, in FY 2001 and FY 2002, improvements to Science and Technology need identification and definition; and provide deployment assistance and regulatory acceptance support to the sites via the Site Technology Coordination Groups and Technical Program Officers.
- In FY 2001, issue a new safety and health policy for EM Science and Technology programs which enhances built-in safety in technology design, clear identification of potential hazards to technology users, and alternate worker safety.
- In FY 2000, FY 2001 and FY 2002, lead the development of a Department-wide compendium of environmental-related research and development activities and perform an analysis to identify possible technology gaps that could impair or prevent accomplishing Environmental Quality business line mission and goals.
- In FY 2001 and FY 2002, support program assessments by the National Academy of Sciences and independent peer review of Office of Science and Technology sponsored technologies (30) by the American Society of Mechanical Engineers.

- In FY 2001 and FY 2002, provide access to international technologies and demonstration sites in Russia, Poland, Argentina, and Canada and facilitate Joint Coordinating Committees for Environmental Management for Russia, Eastern Europe, and Argentina.
- In FY 2002, redesign the Office of Science and Technology web site linking Focus Area and Site Technology Groups information together for single access.
- In FY 2002, develop plans (20) for the primary and secondary deployments of "key" technologies in support of site closure.
- In FY 2002, continue integration with State-led efforts with the Interstate Technology and Regulatory Cooperation Working Group for site specific technology workshops, training, and technology insertion.
- In FY 2002, update the new safety and health policy for Science and Technology programs to reflect lessons learned in its application and from direct experience during its first year.
- In FY 2002, continue EM Laboratory Management oversight role.

Funding Schedule

	FY 2000	FY 2001	FY 2002
Program Information, Review and Analysis	9,250	8,383	6,421
Deployment Assistance	6,274	6,065	5,370
International Technology Coordination	600	760	600
Safety and Regulatory	3,854	4,046	3,500
Total, Technology Applications	19,978	19,254	15,891

Detailed Program Justification

(dollars in thousands)

	FY 2000	FY 2001	FY 2002
Program Information, Review, and Analysis	**9,250**	**8,383**	**6,421**

Sound strategic planning is required to ensure that investments in science and technology provide fully developed technologies on a schedule that enables EM to attain its cleanup goals.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Effective Program planning and management requires that program information be collected for review, analysis, and distribution. This task provides the infrastructure within the Office of Science and Technology to collect and analyze information in an efficient manner. Activities will focus on requesting, collecting, and sorting information from the sites and Focus Areas in support of program planning and reporting, evaluation of the technical performance, communication of program successes and impacts, and the evaluation of program effectiveness. In addition, activities related to EM Laboratory Management oversight will be conducted within this task. Planned FY 2002 activities include:

- Continue to lead the development of environmental research and development activities for the Department's Environmental Quality Business Line.
- Continue to review Science and Technology's strategy, and revise as necessary, to meet EM's evolving cleanup goals.
- Continue providing key information tools in support of business and program management.
- Update and continue cost/benefit information for the application of innovative technologies with emphasis on cost reduction, schedule acceleration, and risk reduction.
- Continue to provide the independent review capability for HQ and Focus Area activities.
- Continue EM Laboratory Management oversight activities.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Deployment Assistance 6,274 6,065 5,370

Deployment of technologies at DOE sites is greatly enhanced through the coordination of technology needs from project inception to completion. The Office of Science and Technology relies on the Site Technology Coordination Groups to coordinate this information and to identify opportunities for technology deployment at each individual site. The activities in this task provide the tools and mechanisms that allow the Office of Science and Technology to build partnerships with the DOE end user to facilitate rapid deployment of newly developed technologies and encourage multiple deployment of technologies across the entire DOE complex. Also included in this task is the coordination and partnership with other Federal Agencies, universities and industry to assure that all up to date information needed to bring innovative technology, processes or knowledge to bear on the EM cleanup mission is available. Planned FY 2002 activities include:

- Continue Site Technology Coordination Groups to link Focus Area technologies to site needs and provide Site specific technology information.
- Support twenty deployment plans for "key" technologies.
- Facilitate multiple deployment of significant technologies at DOE sites.
- Collect technology vendor data.
- Continue to provide technology teams to support sites in the selection of technologies to meet environmental requirements.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

International Technology Coordination 600 760 600

Environmental Management's mission is greatly enhanced and supported through access to international environmental technologies, scientific expertise, technical information, and foreign demonstration sites. Through Memoranda of Cooperation, the Office of Science and Technology collaborates with the scientific communities of Russia, Poland, Argentina and other areas as appropriate, in joint research and development to meet these needs. These efforts ensure continued awareness of opportunities for EM to access relevant foreign environmental technologies, data, and expertise to accelerate cleanup. Through these activities, the Office of Science and Technology leverages the relationships established with the international science and technology community over the past 10 years to maintain access to foreign technologies with minimal increase in investment. Without these efforts, EM sites will not effectively receive the benefit of international technologies and expertise. Planned FY 2002 activities include:

- # Maintain Memoranda of Understanding and Memoranda of Cooperation with foreign governments allowing exchange of technical information.
- # Coordinate technology workshops and demonstrations.
- # Organize annual Joint Coordinating Committees with Russia, Eastern Europe, and Argentina.
- # Provide access to international technologies and demonstration sites in Russia, Poland, Canada, and Argentina.

Safety and Regulatory 3,854 4,046 3,500

Application of new technologies is often delayed or stopped completely from the lack of early and consistent coordination between technology developers, regulators, stakeholders, and end-users. This task provides the tools and mechanisms for creating the partnerships that bring these parties together as part of the technology development effort. Integration of worker safety and health aspects into the technology development process are also considered as part of this task. Activities will focus on conducting training, workshops and assessments, conducted by the States and Industry representatives, of key technologies or specific problem areas in order for the stakeholder community as a whole, to gain a better understanding of the technology. Resulting in wide spread acceptance and application, as well as expedited permitting and technology reviews. Planned FY 2002 activities include:

- # Facilitate integration activities with the State-led Interstate Technology and Regulatory Working Group; conduct on-site and web-based training on radiation risk, Dense Non-Aqueous Phase Liquids technologies, and monitoring/surveillance; produce six to eight protocols and guidance documents on Dense Non-Aqueous Phase Liquids, bionitrification, and other areas to assist/educate regulators and others; and conduct regional/site workshops (Rocky Flats, Ohio, Savannah River Site) and a national lessons-learned colloquium.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Conduct and publish 11 worker health and safety assessments in conjunction with the Office of Science and Technology sponsored technology demonstrations; and continue Human Factor Assessments for enhancement of the effectiveness and efficiency of innovative environmental technologies.

Total, Technology Applications	19,978	19,254	15,891

Explanation of Changes from FY 2001 to FY 2002

	FY 2002 vs. FY 2001 ($000)
Program Information, Review, and Analysis	
# Decrease primarily related to completion, in FY 2001, of economic analysis activities and database enhancements	-1,962
Deployment Assistance	
# Decrease primarily due to completion, in FY 2001, of technology commercialization activities	-695
International Technology Coordination	
# Decrease due to conducting fewer international technology workshops	-160
Safety and Regulatory	
# Decrease due to lower level of support in FY 2002 to the Interstate Technology and Regulatory Cooperation and the Environmental Council of States working groups	-546
Total Funding Change, Technology Applications	-3,363

Small Business Innovative Research Program (Technology Development)

Mission Supporting Goals, and Objectives

Program Mission

Provide funding to the Small Business Innovative Research program for small businesses to participate in research and development activities that benefit the EM program.

Program Goal

The goal of this program is to use technologies developed by the small business community to accelerate and reduce the cost of cleanup at EM sites.

Program Objectives

The objective is to deploy technologies that meet the EM mission as rapidly as possible.

Significant Accomplishments and Program Shifts

In FY 2000, FY 2001 and FY 2002, continue to support this program and provide opportunities for the small business community to make contributions to the EM mission.

Funding Schedule

	FY 2000	FY 2001	FY 2002
Small Business Innovative Research Program (Technology Development)	0	3,723	1,500

Detailed Program Justification

(dollars in thousands)

	FY 2000	FY 2001	FY 2002
Small Business Innovative Research Program (Technology Development)	**0 [a]**	**3,723**	**1,500**

Funding is requested for the Small Business Innovative Research assessment in accordance with Public Law 102-564, which mandates a percentage of all research and development dollars be set aside for grants to small businesses. Once funding is appropriated, it is transferred to the DOE Office of Science for award and administration of grants to small businesses.

Total, Small Business Innovative Research Program (Technology Development	0	3,723	1,500

Explanation of Changes from FY 2001 to FY 2002

	FY 2002 vs. FY 2001 ($000)
Small Business Innovative Research Program (Technology Development)	
# Decrease reflects change in estimated Small Business Innovative Research assessment	-2,223
Total Funding Change, Small Business Innovative Research Program	-2,223

[a] $3,659,000 transferred to the DOE Office of Science for award and administration of grants to small business.

Environmental Management Long-Term Stewardship

Mission Supporting Goals, and Objectives

Program Mission

The Federal Government has a legal and moral responsibility to ensure the protection of public health and the environment from hazards remaining after cleanup of federal sites is completed. The Department of Energy refers to the activities necessary to manage this obligation as long term stewardship. Mission activities associated with long term stewardship include: policy and planning; training and outreach; operation, maintenance, and monitoring of physical and institutional controls; information management; and, a systematic effort to improve the Department's ability to safely and efficiently manage the long term stewardship responsibility.

Program Goal

Long term stewardship is an emerging mission for the Department. Despite significant progress in addressing the legacy of the Cold War, existing plans and agreements with regulators and affected parties, coupled with technical or financial limitations, will result in the majority of the Department's sites not being cleaned up to the point where they can be released for unrestricted use. Thus the goal of the Long-Term Stewardship program is to enable the Department to provide safe and effective long term stewardship from residual hazards while optimizing future land and resource use. Achieving this goal requires the development and implementation of policies, strategic and program planning, issue identification and resolution, as well as oversight functions necessary to ensure the protection of public health and the environment for sites already in long term stewardship.

Program Objectives

Although 34 sites are already in the Department's long term surveillance and monitoring program, the Department's long term stewardship program is in its infancy. In general, the sites that have completed cleanup have either small source terms (residual radioactive hazards) which have been relatively easy to stabilize or are protected by the installation of significant engineered controls. This coupled with the predominantly remote location of the sites and the lack of any continuing missions has, at least to date, resulted in relatively low risk stewardship. However, the Department plans to transition an additional 33 sites into long term stewardship in the next five years. In general, these sites have larger and more complex source terms (radioactive and chemically hazardous materials in varied forms and conditions), are closer to population centers, and several of the sites will have continuing missions. By the end of the Department's cleanup activities, over 120 sites are

expected to require long term stewardship.

The Long-Term Stewardship program is comprised of four major elements: (1) policy and planning; (2) transition to stewardship; (3) operations and maintenance oversight; and (4) continuous improvement. Funding for operations and maintenance of sites in long term stewardship, with the exception of oversight functions, is currently contained within the Idaho Operations Office portion of the budget and is performed by the Grand Junction Office.

Within these four major elements there are a number of objectives:

- prepare strategic, program, and site specific plans that enable the Department to identify, evaluate, and meet its long term stewardship responsibilities.
- establish Department wide policies and procedures that clearly establish the requirements for, and enable the transition of sites into long term stewardship.
- improve the Department's capabilities to make cost effective and publically acceptable tradeoffs between cleanup, long term stewardship, and future land use.
- review, analyze, and improve the current set of institutional controls available for enabling, managing, and enforcing long term stewardship.
- efficiently and effectively support the transfer of sites and portions of sites into long term stewardship to enable reductions in site infrastructure costs.
- provide the oversight necessary to ensure the continued protection of public health and the environment for sites already in long term stewardship.
- establish processes for improved oversight, failure trending and analysis, decision analysis, and improved science and technology investment decisions that enable the Department to make continuous improvements to long term stewardship.

Significant Accomplishments and Program Shifts

FY 1998 through FY 2000 were primarily focused on preparing the initial programmatic baseline for long term stewardship and identifying the major issues associated with the successful implementation of long term stewardship within the Department. Issue identification was supported through a national scoping process required by a Settlement Agreement reached in response to the Programmatic Environmental Impact Statement lawsuit, and research and analysis conducted by independent groups including, but not limited to: the National Research Council, the National Governors Association, the Energy Communities Alliance, and Resources for the Future.

FY 2001 marked the beginning of long term stewardship as a program mission for the Department with an emphasis on strategic, programmatic, and site specific planning. FY 2002 continues to emphasize planning but has an increased focus on resolution of issues interfering with, or potentially delaying, the transition of sites

through closure and into long term stewardship. Issue resolution will be conducted, in partnership with the Field Offices and sites. Priority will be placed on those sites approaching closure and on those issues that are crosscutting in nature. Stakeholder and outreach activities will be shifted to provide an improved balance between national groups coordinated by headquarters elements and local groups coordinated by field elements.

- # Prepared the first long term stewardship program baseline with initial estimates of scope, cost, and schedule. Baseline was submitted as a Report to Congress in accordance with the FY 2000 National Defense Authorization Act.
- # Conducted national scoping and public comment process to prepare a comprehensive national study on long term stewardship issues.
- # Developed and issued guidance for the development of site-specific long term stewardship plans.
- # Supported the development of initial policy regarding the ownership and transfer of sites within the Department into long term stewardship.
- # Completed the development and declared the Central Internet Database (one of the requirements from the Programmatic Environmental Impact Statement lawsuit settlement agreement) fully operational.

Funding Schedule

	FY 2000	FY 2001	FY 2002
Policy and Guidance	1,000	3,700	3,200
Transition to Stewardship	0	1,750	2,500
Operations and Maintenance Oversight	0	300	300
Continuous Improvement	0	1,500	1,500
Central Internet Database	500	750	500
Long-Term Stewardship	1,500	8,000	8,000

Detailed Program Justification

(dollars in thousands)

	FY 2000	FY 2001	FY 2002
Policy and Guidance	**1,000**	**3,700**	**3,200**

(dollars in thousands)

FY 2000	FY 2001	FY 2002

The emerging mission of long term stewardship within the Department provides a set of unique policy challenges as well as a requirement for extensive planning. The policy challenges include the development and implementation of: requirements and procedures for the transfer of sites into long term stewardship; rigorous and redundant engineering and institutional controls; record keeping and information management requirements; decision-aiding tools for evaluating alternative cleanup scenarios and their impacts on stewardship; life-cycle cost estimation techniques; financial mechanisms for long term stewardship; and, an effective management approach within the Department for enabling current and future missions within the constraints of safe and efficient long term stewardship.

The Department has embarked on long term stewardship planning efforts at three levels. At the top level the Department will be constructing a strategic plan for long term stewardship that addresses sites that are closing, as well as, sites with continuing missions. In parallel with the strategic planning effort, the Department is developing a long term stewardship program plan. The program plan will identify the major activities that the Department must take over the next five years to ensure successful management of its long term stewardship responsibility. The third level of planning will be done at the geographic site level. Each site, regardless of expected closure date, will develop a plan for long term stewardship by 2004. This advance planning will allow sites to factor stewardship considerations into cleanup decisions as early as possible. Planned FY 2002 activities include:

- Establish policies for information management and record keeping the enable the Department to meet the unique challenges of long term stewardship.
- Review and analyze cleanup decisions with respect to long term stewardship implications. Establish changes to procedures or processes to introduce stewardship considerations earlier in the decision-making processes.
- Develop and start implementation of life-cycle cost estimating techniques for long term stewardship that enable improved decision-making.
- Evaluate financial options and alternative institutional approaches for ensuring adequate resources are available to meet long term stewardship requirements.
- Develop and start implementation of a Department-wide strategic plan for long term stewardship.
- Establish corporate performance measures that can be used to both drive and evaluate the Department's success in long term stewardship.
- Develop and start implementation of a fully integrated Department-wide program plan for long term stewardship.
- Support the preparation of site-specific long term stewardship plans at 40 plus sites around the complex.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Transition to Stewardship **0** **1,750** **2,500**

Over 30 sites or portions of sites are expected to transition from cleanup to long term stewardship in the next five years. The source terms at those sites will be either larger, more complex, or have higher risk to the public and the environment than those sites previously transferred. Efficient and effective transfer of these sites into long term stewardship will allow the Department to eliminate or substantially reduce costs associated with site infrastructure. However, achieving this will require improvements in the following areas: information management and public access to records; land use planning, particularly as it relates to state, tribal and local governments; the use of engineering and institutional controls; and, performance assessment and verification tools that can effectively demonstrate to federal and state regulators that cleanup is completed and long term stewardship can begin. In addition, the Department is expected to face growing pressure to consider stewardship responsibility for non-federal, low-level waste disposal sites under Section 151(b) of the Nuclear Waste Policy Act. The potential federal environmental liability of these sites is not well understood.

The Department is tackling the challenges associated with transferring sites into long term stewardship at several levels: coordination with other federal agencies; interaction with national organizations; and, solving site specific issues. Several federal agencies, in particular the Department of Defense, are land owners who are embarking on long term stewardship missions. In addition, two federal agencies, the Nuclear Regulatory Commission and the Environmental Protection Agency are faced with oversight of non-federal sites that will be cleaned up but require long term stewardship. The cost of long term stewardship to the federal government can be reduced if there is adequate coordination across federal agencies. National organizations are rapidly engaging on this complex issue as evidenced by long term stewardship committees being established by the National Governors Association and the Environmental Council of States. Effective communication and coordination at the national level will result in stewardship decisions that are safer and more cost effective. Sites planning to transition into long term stewardship within the next ten years are actively managing stewardship issues today. The majority of funding requested in this activity will be used to support site specific or cross-cutting issues facing those sites. Specifically, technical assistance, training, and funding will be provided to sites to enable transition to stewardship. In FY 2002, planned activities include:

- Transfer site record keeping and information management from a cleanup orientation to those required for long term stewardship with an emphasis on public access.
- Support the development, communication, and use, of engineering and institutional controls at the site level.
- Support land use planning activities for long term stewardship particularly as it relates to the use of “brown fields” or reindustrialization and the responsibilities of state, tribal and local governments.
- Provide and oversee the implementation of performance assessment and verification tools for ensuring long term stewardship requirements are met.
- Review and evaluate the potential environmental liability to the federal government of non-federal sites regulated by the Nuclear Regulatory Commission.

(dollars in thousands)

FY 2000	FY 2001	FY 2002

Operations and Maintenance Oversight **0** **300** **300**

As of January 2001, 34 sites had completed the successful transition to long term stewardship and are under the purview of the Grand Junction Office's long term surveillance and monitoring program. To date, site monitoring has shown that engineering and institutional controls can be used effectively to prevent damage to human health and the environment from residual hazards. However, as previously noted, the sites currently in stewardship have relatively low levels of risk associated with them and the time spent in stewardship has been relatively short. Operations and maintenance of sites in long term stewardship is conducted by the Grand Junction Office and the majority of funding is contained in the Idaho portion of the budget. In FY 2002, planned activities include:

- Provide oversight to ensure that sites in long term stewardship remain fully compliant with applicable regulations, and that surveillance, monitoring, and maintenance activities are conducted in accordance with approved site-specific long term stewardship plans.

Continuous Improvement 0 1,500 1,500

The very nature of the problem requires the Department to review, analyze, and invest in improvements to long term stewardship. The cost of long term stewardship will be significantly less than cleanup; however, safely maintaining the protection of public health and the environment for decades, let alone thousands of years, will require significant resources. Failure trending and analysis tools, as well as other decision tools, are needed to determine the uncertainty of the long-term effectiveness and permanence of engineering and institutional controls. It must be assumed that containment structures, caps, and subsurface barriers will fail. Failure could result from the impact of natural disasters or the gradual breakdown over time of engineered controls. In a number of cases, it is expected that the potential value of the land and/or the facilities in long term stewardship will increase to the point where more active use will be cost effective. Effective stewardship will enable the development and use of these "brown fields" as time progresses. Targeted investments in science and technology will result in technological improvements that can have a significant impact on the cost of long term stewardship and the ability to improve the use of land and/or facilities. Planned FY 2002 activities include:

- Establish a systematic process to analyze degradation and failures to establish trends and develop options to mitigate failures and their impacts.
- Evaluate the existing and planned stewardship baseline for opportunities to change the remedial action strategy or existing remedy to enable improved land or facility use.
- Develop a science and technology roadmap that identifies critical research needs for effective long term stewardship.

(dollars in thousands)

	FY 2000	FY 2001	FY 2002
Central Internet Database	**500**	**750**	**500**

The Department developed the Central Internet Database pursuant to the terms of a legally binding agreement that settled a lawsuit regarding the EM Programmatic Environmental Impact Statement. While the Central Internet Database was made available to the public in January 2000, it did not meet the requirements of the lawsuit and was not fully operational. The Central Internet Database contains data on the Department's waste, contaminated media, facilities, and spent nuclear fuel. There are no data calls associated with the Central Internet Database; all data is obtained from other Departmental information systems. The Department is obligated to maintain the system for at least six years from the time it is declared fully operational. Responsibility for this system is being transferred to Environmental Management's Chief Information Officer. FY 2002 will be the last year funding is requested in the Long Term Stewardship budget request. Planned FY 2002 activities include:

Maintain the Central Internet Database operational. Update the database with new information and respond to inquiries and requests.

Total, Long-Term Stewardship	1,500	8,000	8,000

Explanation of Changes from FY 2001 to FY 2002

	FY 2002 vs. FY 2001 ($000)
Long-Term Stewardship	
# No change.	0
Total Funding Change, Long-Term Stewardship	0

Excess Facilities

Program Mission

The mission of the Defense Excess Facilities, carried out for the Department by the Environmental Management Program in collaboration with the transferring programs, is to manage the transfer for the final disposition of excess contaminated physical facilities leading to significant risk and cost reductions. This will facilitate the cross-program transfer of excess contaminated facilities from the Offices of Defense Programs and Nuclear Energy to Environmental Management (EM) along with the associated deactivation and decommissioning activities.

Program Goal

The Department's overall goal of the Defense Excess Facilities is to resume the transfer and disposition of the excess contaminated facilities from across the Department's many programs for deactivation and decommissioning. Many of these facilities have existed far beyond their intended useful life and require expenditures of significant surveillance and maintenance funds to remain in a safe condition. Deactivation and decommissioning, when complete, will reduce or eliminate these expenditures.

In FY 2002, the Department will resume the transfer of contaminated excess facilities to EM from other programs for management and deactivation and decommissioning. These will be the first transfers under DOE Order (435.1A) on Life-Cycle Asset Management, revised in October 1998. The Department anticipates that additional excess facilities will transfer to the EM program for disposition in future years. These transfers will set the stage for the cleanup of facilities no longer needed for mission work to begin in accordance with EM cleanup priorities. Additional funding is necessary to actually accomplish decommissioning of these facilities.

Program Objectives

- Establish an efficient and effective, long-term approach for managing the transfer of excess facilities to EM.
- Maintain excess facilities in a safe and stable condition until deactivation and decommissioning activities can begin.